Tappi

PUBLISHED BY THE TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY

JANUARY 1955

VOLUME 38 • NUMBER 1

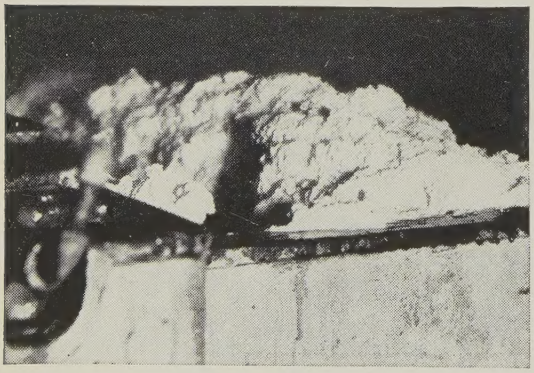
BETTER PAPER

through Hercules Chemicals

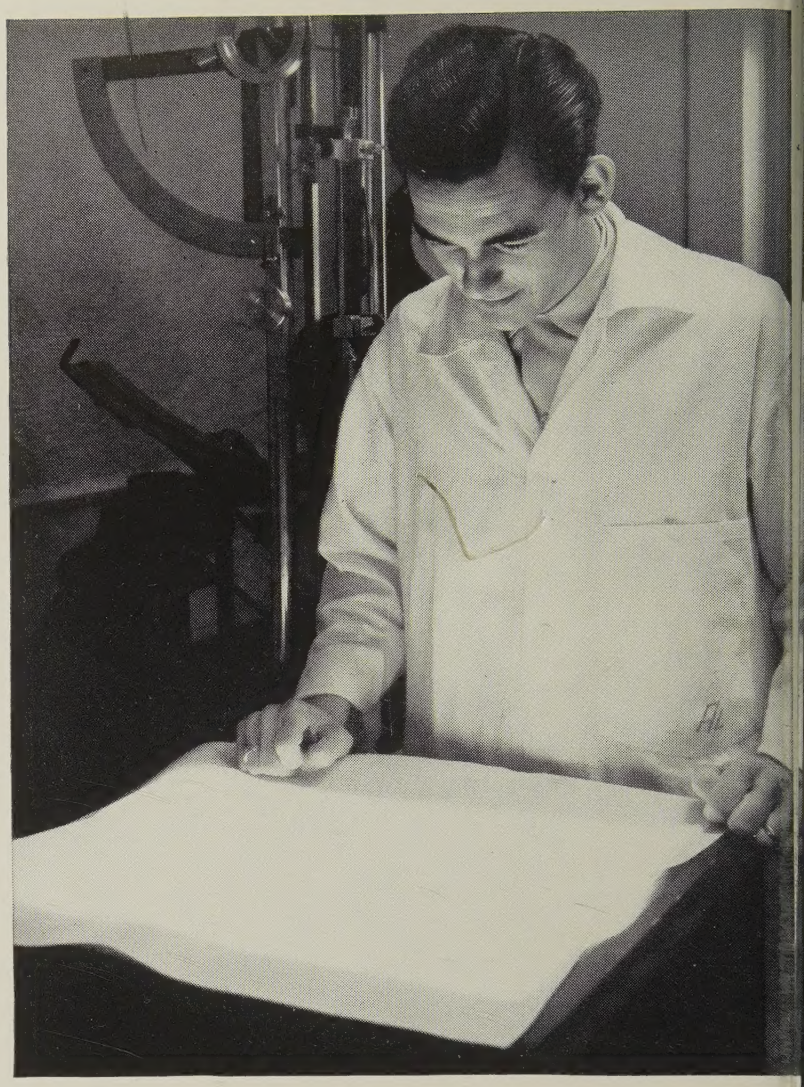
Hercules® Defoamer 4 kills foam economically and contributes to improved quality paper and board.

A 2½ pound brick of Defoamer 4 readily disperses in water to make 40 gallons. And the convenience of the brick form means no waste, no mess, and no heavy drums to handle or ship.

Where foam is a problem, we would welcome the opportunity to discuss with you what our defoamers might do to improve the quality of your product. Hercules defoamers are available in liquid and paste forms as well.



FOAM such as this impedes production, lowers the quality of paper and board. It can be economically controlled by the use of Hercules' defoamers.



EYE APPEAL—This paper is being examined over a light box to check for formation and defects. The right defoamer can be helpful in obtaining good visual appearance of the sheet.

CONVENIENT PACKAGE—Defoamer 4 bricks are available from any of Hercules' strategically located supply points.

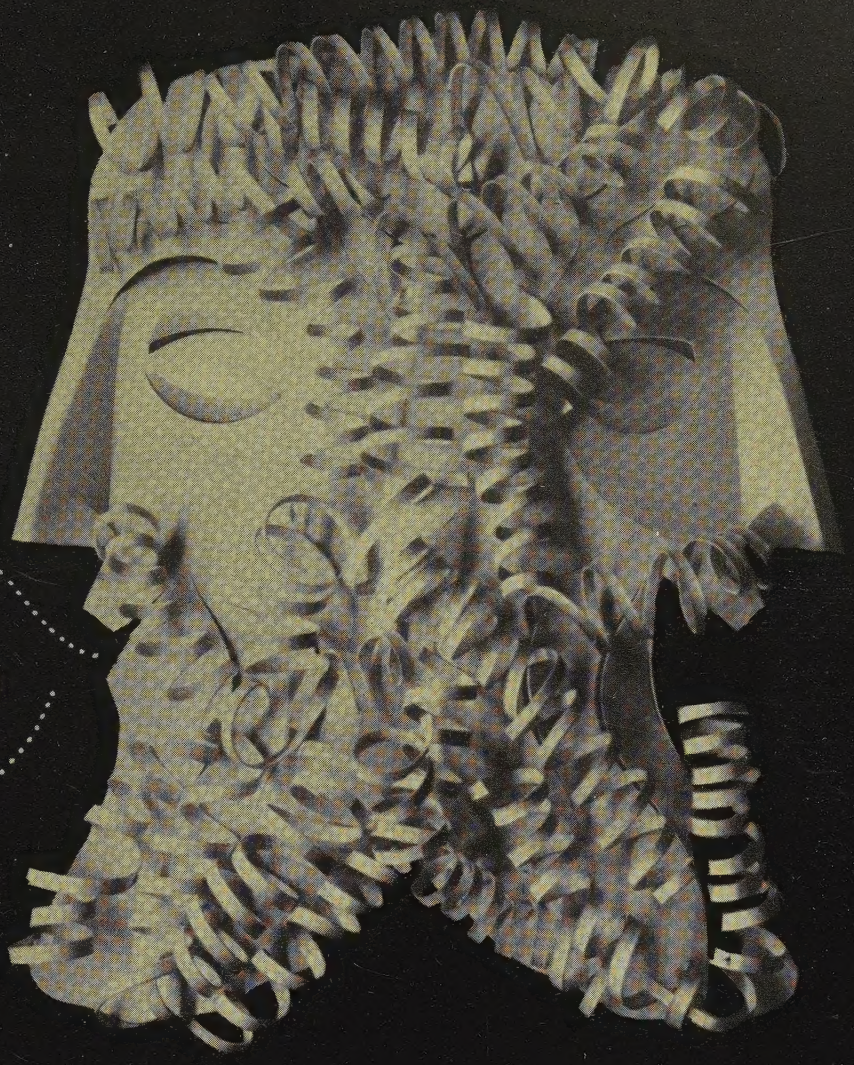
Paper Makers Chemical Department

HERCULES POWDER COMPANY

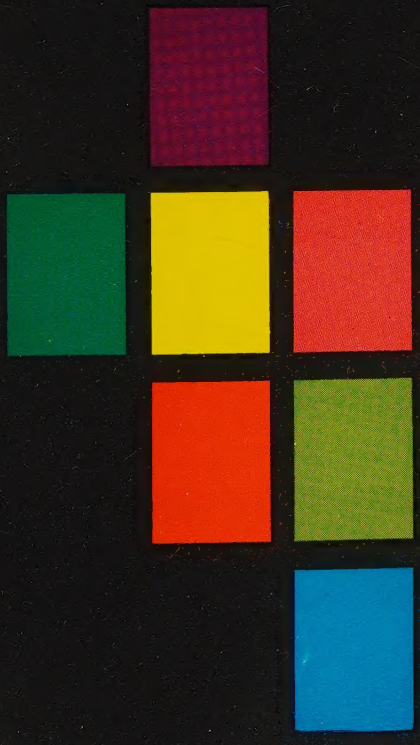
INCORPORATED

967 King Street, Wilmington 99, Delaware

PP54



Fastusols®
for minimum two-sidedness



A complete range of non-dusting, fast to light dyestuffs, the FASTUSOLS generally produce shades of the highest degree of non-two-sidedness and therefore are of particular interest for coloring all high-grade papers, sulphite bond, ledger and cover papers. All these brands may be added dry to the beaters without showing color specks.

In addition to these valuable properties, most of the dyes in this class are readily bleachable with chlorine for simplified reuse of broke, while some which are not bleachable are of interest for record papers such as ledger, where fastness to ink-eradicator is desirable.

GDC dyes backed by prompt deliveries and skilled technical service will provide the answers to all your paper coloring problems.

Write or call our nearest sales office.

From Research to Reality

gdc gaf

GENERAL DYESTUFF COMPANY

A SALES DIVISION OF GENERAL ANILINE & FILM CORPORATION

435 HUDSON STREET • NEW YORK 14, NEW YORK

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saleable

for more tons per day

John Howell, Albany Felt sales engineer, and Charles E. Radley, Vice Pres. and Mill Supt. of Columbia Box Board Mills, Inc., discuss felt operation on the mill's board machine at the Chatham, N. Y., plant, considered to be one of the highest producers per inch of trim in the industry. Columbia considers Albany felts an integral part of their record production of "more tons per day."

call in your Albany sales engineer

Albany Felt's technically trained sales engineers are your source of the information and assistance you need to get the most efficient production from your felts. They are backed by the industry's leading service engineers and designers, outstanding chemical and mechanical laboratories, an extensive research and development program and products *famous* for uniformity.

Take advantage of this top combination of technical "know how" by calling in your Albany sales engineer to help solve felt operation problems. Let him show you how proper application of Albany felts can help you maintain top production and sheet quality. The result: "More SALEABLE Tons Per Day!"

FREE! Felt Performance Record Book for Mill Superintendents, Managers, Purchasing Agents. Write for your handsome leather binder containing convenient forms for maintaining records and graphs of felt performance, felt inventory, etc.

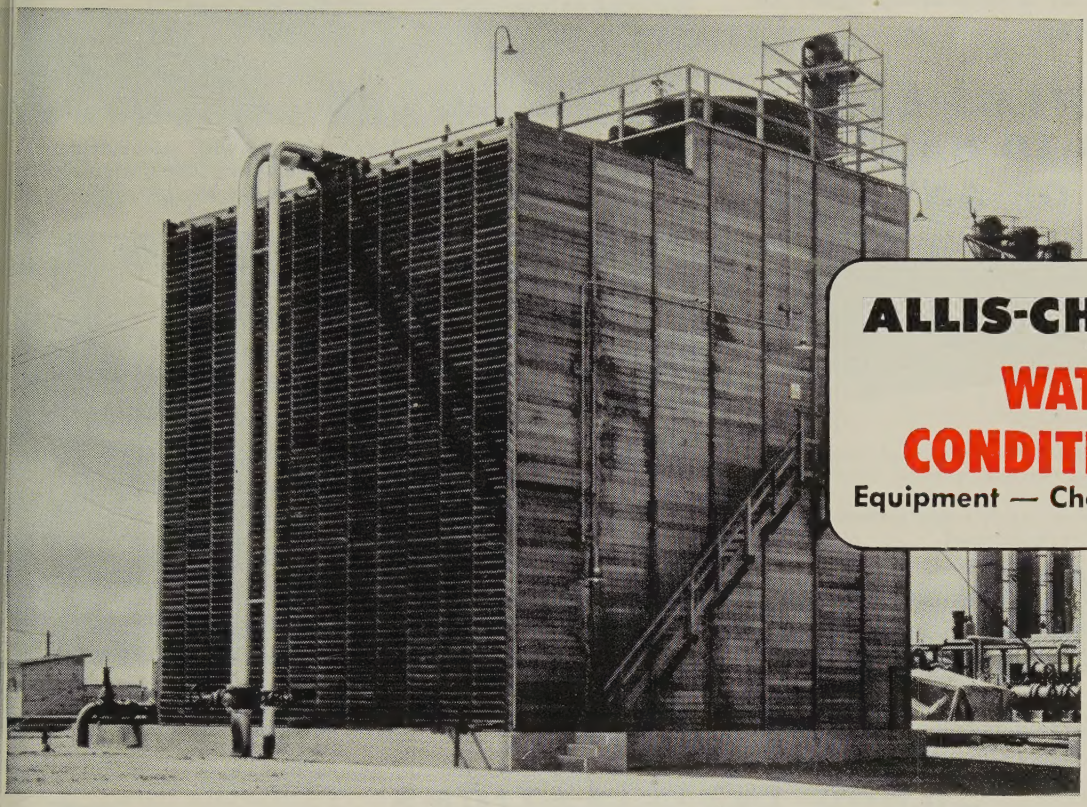
ALBANY FELT COMPANY

"World's largest Manufacturer of Paper Machine Felts"

MAIN OFFICE AND PLANT, ALBANY 1, NEW YORK

Other plants: Hoosick Falls, N. Y., North Monmouth, Maine, Cowansville, Quebec.

SOLVING WATER PROBLEMS in Cooling Towers



ALLIS-CHALMERS
WATER CONDITIONING
Equipment — Chemicals — Service

Use of cooling towers to save on water brings unusual problems. Some of these problems are corrosion, scaling, algae and slime, and deterioration of wood in the tower. Allis-Chalmers recently published an informational bulletin, Number 47A, which explains the causes of these problems and what can be done about them.

Part of Practical Library

This bulletin is one of a series published by Allis-Chalmers to help you understand the causes and solutions of many water problems. It is the result of Allis-Chalmers experience solving water problems for every industry, in addition to solving problems involved in the company's own broad line of steam turbine and power plant equipment.

Complete Water Conditioning Service

Allis-Chalmers offers complete water conditioning service. You can get analyses and reports on your problems. You can get chemicals needed in water treatment. And you can get the equipment needed for any system.

A-4316

Get Information — For your copy of Bulletin 47A on water treatment for cooling towers, write Allis-Chalmers, Milwaukee 1, Wisconsin. Or better, call your nearby A-C district office to have an Allis-Chalmers water conditioning engineer consult with you on your problems.

ALLIS-CHALMERS

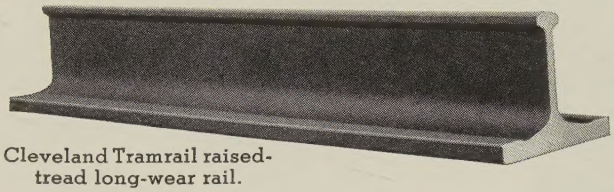
A-C ALLIS-CHALMERS

MATERIALS HANDLING IN THE PAPER INDUSTRY

Many paper mills and paper products plants are enjoying numerous advantages possible with Cleveland Tramrail. They are speeding production and lowering costs by eliminating rehandling. They are reducing floor congestion and removing hindrances and confusion. They are aiding safety. They are using overhead space to save floor space. They are reducing spoilage and greatly increasing warehouse capacity by eliminating need of aisles and piling higher.

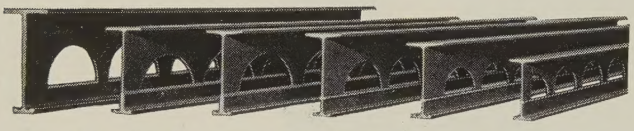
A Cleveland Tramrail cab-operated crane with motor-driven screw grab serves this 8000-ton pulp storage. The grab picks up three bales at a time without operator leaving cab.

STANDARD ITEMS EASILY COMBINED TO HANDLE MATERIALS OF ANY KIND

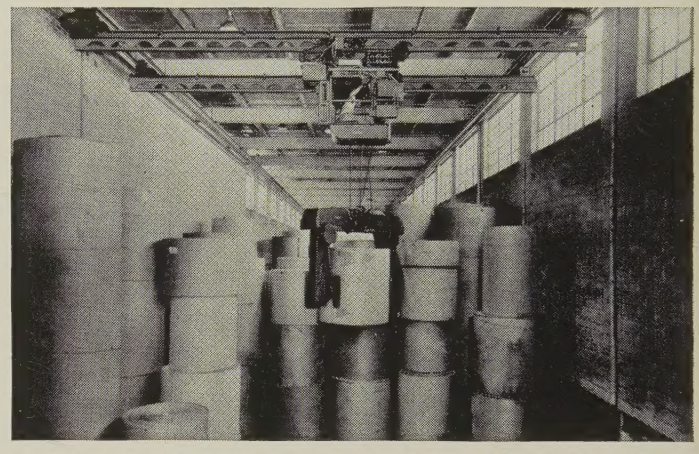


Cleveland Tramrail raised-tread long-wear rail.

Cleveland Tramrail consists of standard items such as rail, switches, carriers, cranes, hoists, grabs, etc., which can be combined in a thousand-fold ways to serve nearly every materials handling requirement.

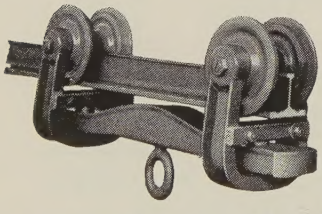


Cleveland Tramrail Archbeam in seven sizes for various loads and conditions.



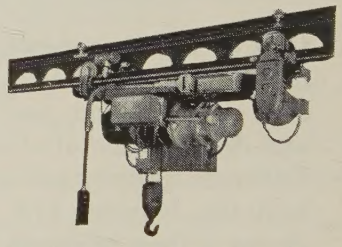
This Cleveland Tramrail crane with motorized roll grab picks up rolls weighing as much as 6000 lbs., sets them down or turns them from vertical to horizontal position.

30,000 INSTALLATIONS



Hand propelled carrier built for long life and easy operation. Wheels have hardened tread and flange; bearings are double race type.

Backed by experience with 30,000 installations in industries of all types, Cleveland Tramrail representatives are in exceptionally good position to serve you. They will gladly advise, survey your plant, make layout or prepare quotation without obligation.



Motor-driven carrier with electric hoist. One of many types built by Cleveland Tramrail.

GET THIS BOOK!

BOOKLET No. 2008. Packed with valuable information. Profusely illustrated. Write for free copy.

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THE CLEVELAND CRANE & ENGINEERING CO.
8311 EAST 287th STREET • WICKLIFFE, OHIO

CLEVELAND TRAMRAIL

OVERHEAD MATERIALS HANDLING EQUIPMENT

JANUARY 1955

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MEXICO
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DORRCO

ON January first of this year, Dorr-Oliver Incorporated became a corporate entity through the merger of The Dorr Company, Engineers and Oliver United Filters Incorporated. Not a merger in name only, the combined staffs, engineering skills and facilities of the two organizations are being welded into a single unit, with a vastly increased capacity to serve on a worldwide basis.

Both companies have their roots in gold ore metallurgy. The Dorr Company was founded by John Van Nostrand Dorr on his early inventions, the first of which was developed in 1904 to solve the problem of mechanical classification of gold ores. Oliver United had its beginning in 1907 with the development of the first successful continuous vacuum filter by Edwin Letts Oliver and its practical application to the cyanide process. Since their inception, both companies have grown steadily in technical stature to positions of leadership in their ever-widening and complementary, fields.

This cumulative, combined experience . . . coupled with a progressive faith in the future . . . is the strength of Dorr-Oliver. For present and future clients alike throughout the world it means better solutions to process problems in those fields of metallurgical, chemical, industrial and sanitational engineering in which Dorr and Oliver have specialized for nearly half a century.

DORR-OLIVER
INCORPORATED
STAMFORD, CONNECTICUT, U. S. A.

Edwin Letts Oliver, Founder and President of Oliver United Filters, at left and John Van Nostrand Dorr, Founder and Chairman of the Board of The Dorr Company, at right. The globe, long symbolic of worldwide operations, stands in the home office of the new corporation in Stamford, Connecticut.

UP TO 67% SAVINGS ON POWER WITH AN

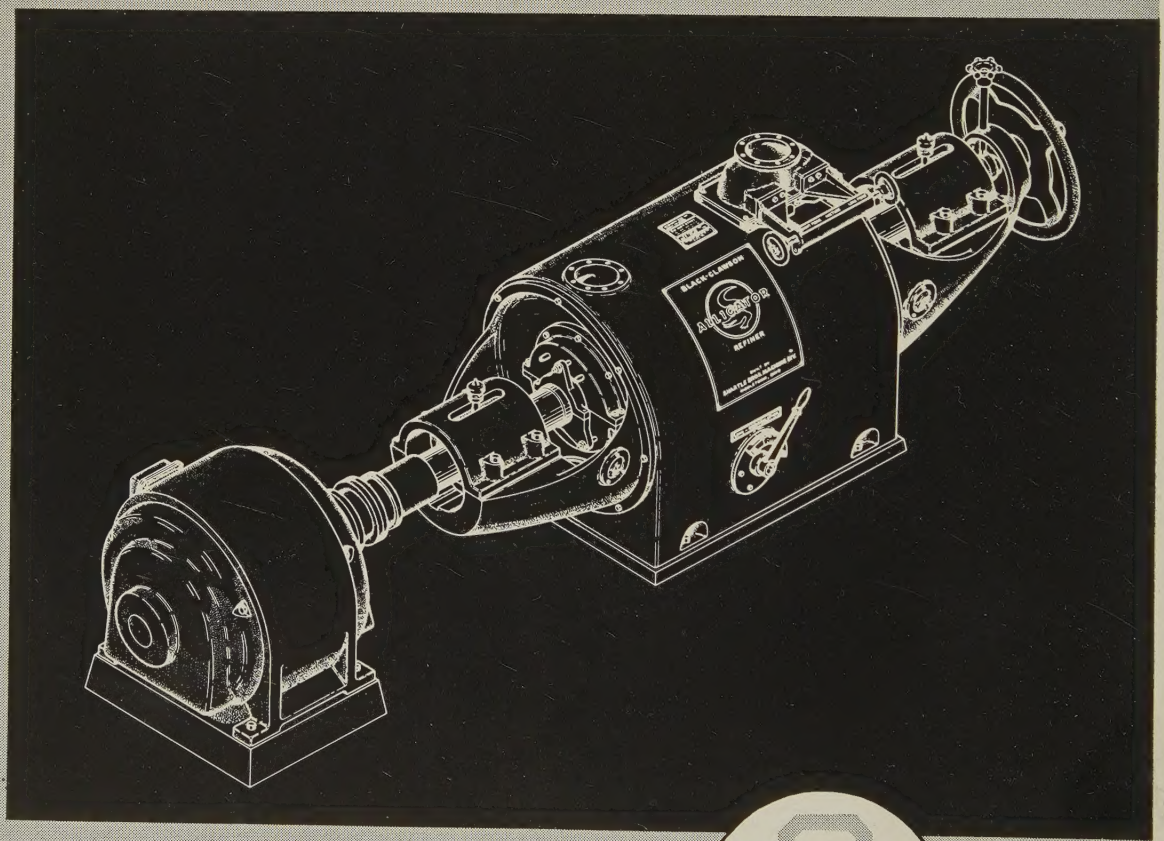
ALLIGATOR REFINER

At last a new and distinctly different kind of conical refiner—The Alligator—becomes available to American mills.

Reports from Europe, where some 150 are in service, disclose power savings of 30%—40%—50%—up to 67%—depending on the type of stock being processed. Exhaustive pilot plant tests at our laboratories at Fulton add confirmation.

Equally important—perhaps even more important—tests for Mullen, tensile, tear, shrink and fold, based on a given freeness, show marked improvement. These claims have also been confirmed by the laboratories at Fulton.

Have us lay the entire Alligator story before you. It is very, very interesting. Contact the Shartle Division for Bulletin No. 19 SB.



BLACK-CLAWSON

SHARTLE BROS. MACHINE DIVISION • MIDDLETOWN, OHIO

A message to PULP AND PAPER MILL MANAGEMENT

Here's how you can use

STRATEGIC PURCHASING

to help your company maintain a sound competitive position

As profit margins tighten, your purchasing strategy becomes a vital force for success.

The way you purchase heavy chemicals, for instance, can influence your company's profits in the years ahead.

So it becomes increasingly important for you to seek every possible economic advantage when you select a chemical supplier.

Here, for example, are a few things to look for, when deciding on a source for caustic soda, chlorine, and other chemicals:

1. Supply security. How flexible are your supply lines? For instance, a supplier with plants located on deep water may be able to offer you a choice of rail or water delivery. This can insure you steady supply, in case of rail service interruption.

2. Engineering help. A supplier's engineering staff can often be valuable to you when you are setting up a new bleaching process or caustic and chlorine handling systems—not only with advice, but with actual design assistance.

3. Smooth processing. You'll find it helpful to work with the supplier's technical service men who visit you periodically. Often these men can spot potential problems and ward them off before they cause you trouble.

4. Safety programs. Your men can benefit from safety suggestions offered by your supplier. You should have on tap the latest in safety equipment, plus up-to-date information on safe handling of chemicals.

5. Economy. Choose a supplier who wants to help you cut your operating costs; who will go all the way with you in arriving at the best, most advantageous method of shipping and handling for your conditions.

6. Experience. Above all, choose a supplier who is familiar with your industry. It takes years of experience to acquire an understanding of the problems you face, and the know-how to help you solve them quickly and economically.

Are you getting your fair share of these strategic purchasing advantages?

Many of our friends in the pulp and paper industry feel that they get these advantages in buying from Hooker, closely associated with the pulp and paper industry for 50 years.

In the light of the growing importance of these factors, isn't this a good time to review your policies on sources of chemical supply?

HOOKER® CHEMICALS

4-2039

1905—Half a Century of Chemicals from the Salt of the Earth—1955

HOOKER ELECTROCHEMICAL COMPANY

4704 Buffalo Ave., Niagara Falls, N. Y.

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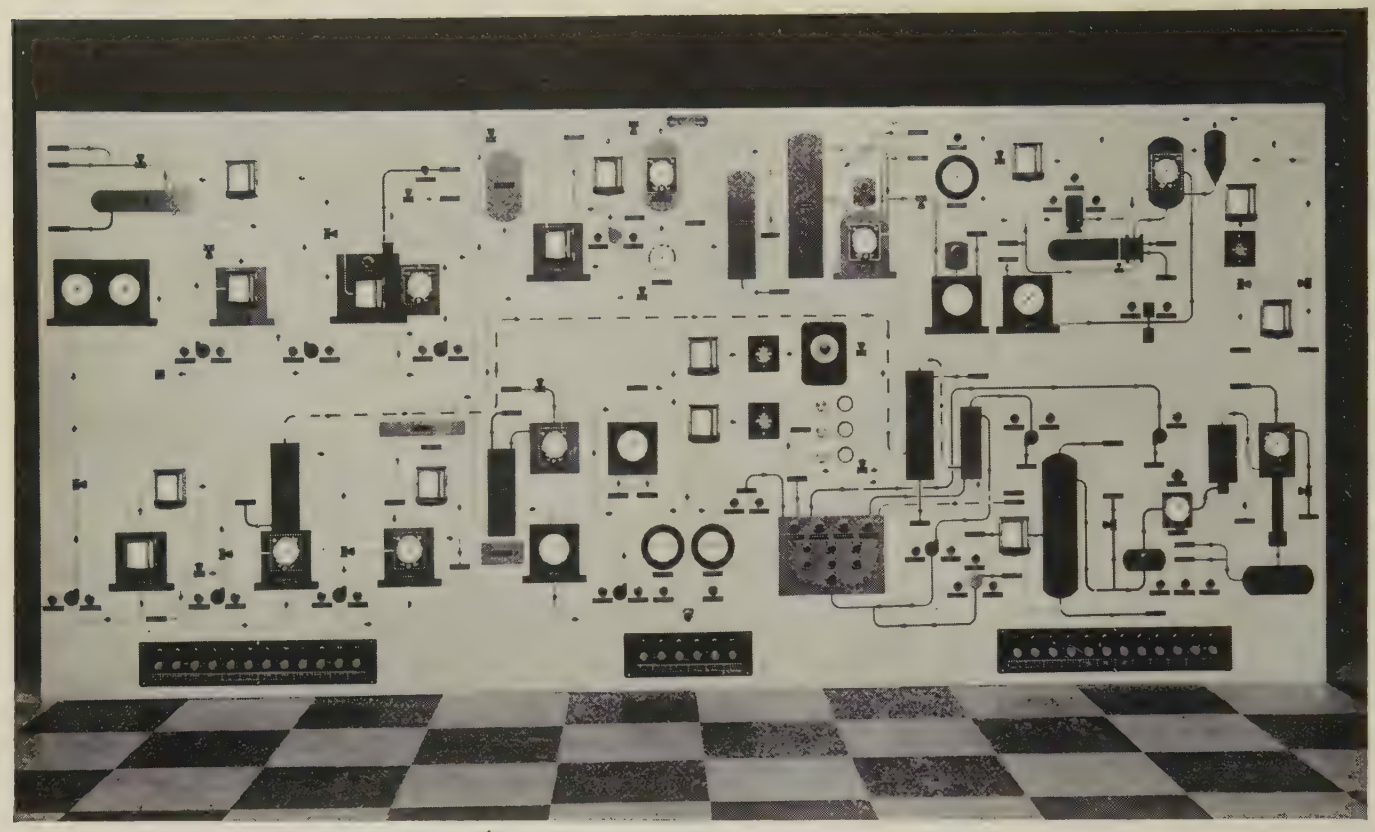
ASK THE



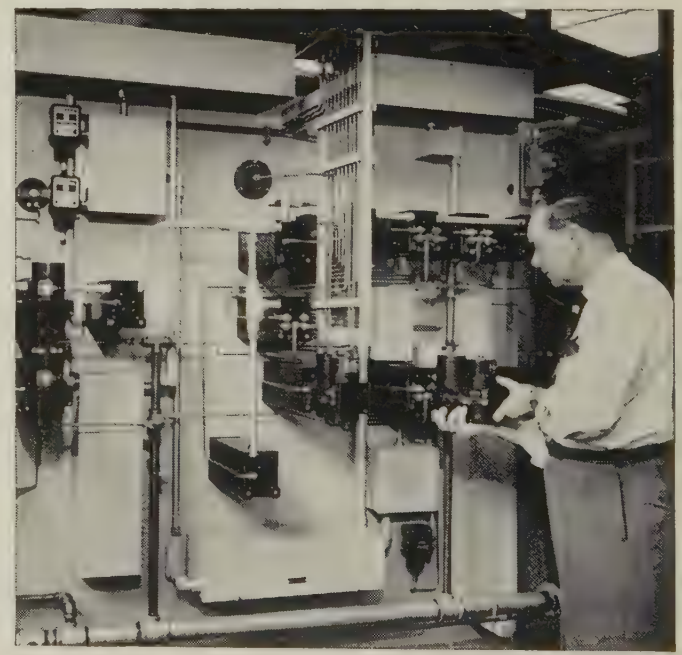
Here a compact Taylor built graphic panel reveals to an operator or a process engineer the complete flow diagram for the chlorine plant of a well-known Southern Paper Mill. The miniature TRANSET Recorders and Indicators not only tell what is happening in every critical point in the process, but also provide every facility for efficient process control.

Advantages of Taylor Miniature Instrumentation

The refinements of the Taylor TRANSET* System are especially appreciated on graphic panels. Panel size is reduced, mounting is simplified, and there are fewer piping connections. Maintenance is easier, and labor and material costs are lower—*all at no premium to you!* Here are some of the outstanding advantages of the TRANSET System which make it ideal for graphic panels. They are the result of years of experience and constant refinements.

- **Interchangeable indicating or recording receivers.**
- **One standard cut-out accommodates 12 different forms of recording and 11 different indicating receivers.**
- **Only one mounting required for each control station, because controllers plug into backs of receivers.**
- **No heavy space-stealing supports are required.**
- **Only half as much space per control station—means greater accessibility and convenience.**
- **Only three piping connections needed per station.**

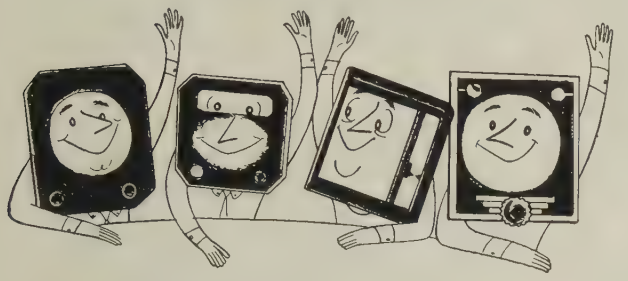
*Reg. U.S. Pat. Off.



Eloquent indeed is this behind-the-panel view of a section of a graphic panel. Note the economy of piping, neatness and simplicity of arrangement, and accessibility for maintenance. Plugging-in a controller is a 10-second job.

TAYLOR PANEL-

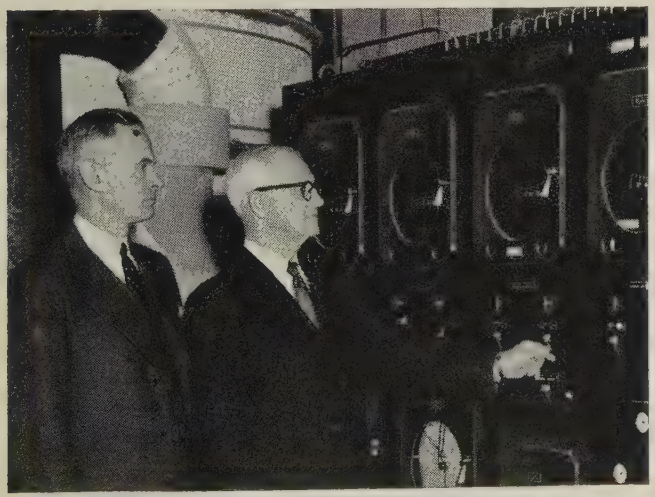
what's happening at any critical point in your processing



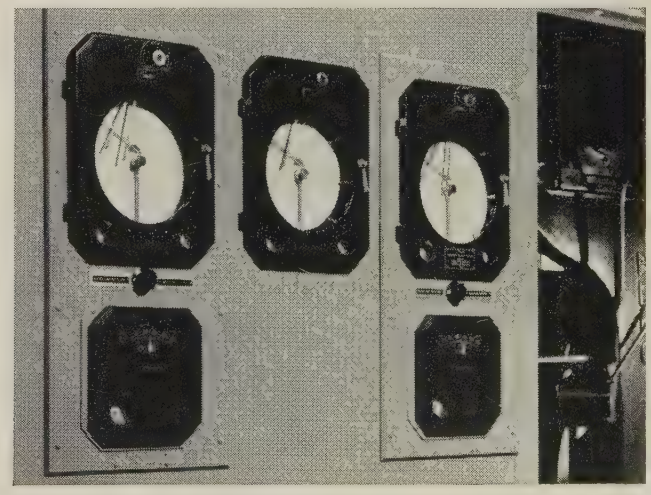
AN IMMEDIATE and accurate answer can be obtained from centralized control by panel instrumentation. It will pay real dividends on your instrument investment. Not only in more efficient production control, and greater protection to the instruments, but in giving your operators a greater sense of responsibility and "good housekeeping".

Taylor panels are custom made to meet your specific needs, whether they be: **Cabinet types** where enclosure of all units is desirable; **Open types**—where protection from dust or injury is not necessary; **Sectional panels**—which can be joined together to form future complete panels; **Graphitrol panels**—diagrammatic, graphic panels of outstanding design for completely centralized instrumentation. All are simple in design, neat in appearance, sturdily constructed and adaptable for any instrument selection.

Top quality workmanship is built into every Taylor panel. Our engineers have the experience and the know-how, based on a great volume and wide variety of panel production over many years. A staff of experts is ready to counsel you in the best solution for *your* problem—and Taylor accepts *full* responsibility for doing the complete job, from helping you select the right panel, through its layout, instrumentation and piping, to insuring satisfactory operation. Your Taylor Field Engineer can give you further information, or write Taylor Instrument Companies, Rochester, N. Y., or Toronto, Canada.



Technical director G. K. Dickerman and Appleton Division Manager L. E. Smith of Consolidated Water Power & Paper Company point with pride to the information given them by the main control panel of their anti-pollution system.



Cabinet type panel for Stamm Moisture Controls at a large South Eastern Kraft Plant. User reports: "Our operators would rather work with the Taylor equipped Stamm Control than any other."

Taylor Instruments MEAN ACCURACY FIRST

Stebbins Linings...

Important in Chlorine Dioxide Bleaching

Approximately 90% of the pulp bleached with chlorine dioxide in plants now operating or under construction will be processed in equipment lined by Stebbins.

Stebbins-lined chlorine dioxide reactors, generators, absorbers, storage tanks and bleach towers, including the very first installation, are giving excellent service.

The pulp industry can depend on Stebbins experience, research, engineering and construction know-how to meet the requirements of new processes.

SINCE 1884
Specialists in Design Installation and Servicing of Linings and Tile Tanks

SEMCO

STEBBINS
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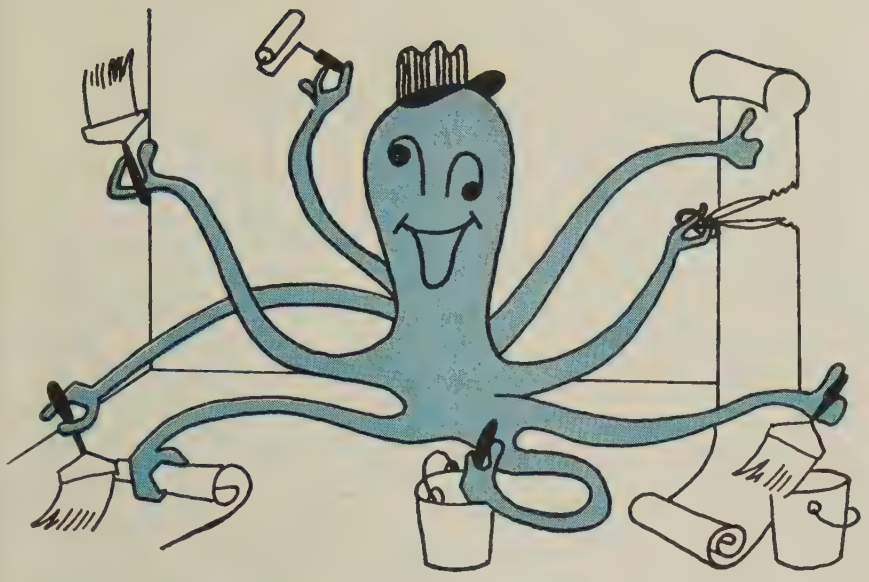
CANADIAN STEBBINS ENGR. & MFG. CO., LTD. — CASTLE BLDG., MONTREAL, CANADA



The difference is—

PAREZ® Resin 607

is as efficient as an 8-armed paperhanger

Once in your paper mill, PAREZ 607 goes to work like a one-man gang. Here are the 8 big jobs it does—the 8 big reasons why PAREZ 607 is preferred by so many mills:

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3. **PAREZ 607** is efficient in low, high and neutral pH's, and at lower drier temperatures, too.
4. **PAREZ 607** needs no alum or catalysts . . . reduces wet press sticking.
5. **PAREZ 607** cuts beater time and power costs . . . gives better drainage, faster drying, higher dimensional stability and lower tendency to curl.
6. **PAREZ 607** improves wax and rosin size efficiency . . . gives less foam trouble on machines, less "pitch" in systems.
7. **PAREZ 607** dry powder in bags means lower shipping costs, easier handling, less storage space . . . and, it has a shelf life well over a year.
8. **PAREZ 607** is a MELOSTRENGTH® resin, the fastest mover in the paper market . . . backed by the national MELOSTRENGTH Promotion Program.

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Don't judge the effect of size color on paper brightness until you try it. Recent tests of a number of sizes in bleached sulphite pulp showed that color of size is not wholly related to brightness of sized paper. Your Cyanamid representative can give you the details.

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Highest pick test a western mill has ever had on starch coated offset sheet was secured by addition of PAREZ 620 Resin at rate of 20% on starch weight. Dennison Pick went from 11 to 20 on felt side, and 14 to 20 on wire side.

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TAPPI Annual Meeting Program

Commodore Hotel, New York, N. Y., Feb. 21–24, 1955

TAPPI 40th Annual Meeting

The 40th Annual Meeting of the Technical Association of the Pulp and Paper Industry will be held at the Commodore Hotel, New York, N. Y., on Feb. 21–24, 1955.

Members of the Association should remember to bring their 1955 membership cards with them since the lower registration fee will be limited to individuals who can present their 1955 cards. All individuals attending the Annual Meeting must register.

MONDAY, FEBRUARY 21, 1955

9:30 a.m. First General Session (East Ball Room)

G. H. PRINGLE, President of TAPPI, Mead Corp., Chillicothe, Ohio, *Chairman*

1. Secretary's Report, by R. G. Macdonald.
2. President's Address, by George H. Pringle.
3. Report of the Tellers Committee.
4. Report of the Joint Textbook Committee, by R. S. Kellogg, *Secretary*.
5. "Research Facilities at Lowell Technological Institute," by John Lewis, Professor & Head, Dept. of Paper Engineering, Lowell Technological Institute, Lowell, Mass.
6. "A New Dry Felting Process for Making Tissues, Batts, and Boards," by Bror E. Anderson, A. B. Dick Co., Chicago, Ill., and James d'A. Clark, Consulting Engineer, Longview, Wash.

9:30 a.m. Statistics Committee (Room B)

10:00 a.m. Packaging Materials Testing Committee (Room F)

12:30 p.m. Chemical Engineering Committee (Luncheon)

12:30 p.m. Engineering Research and Machine Design Committee (Luncheon)

2:00 p.m. Committee Meetings (Grand Ball Room)

All committee meetings will be held in the Grand Ball Room unless otherwise indicated.

Tables assigned to committees will be designated by table cards.

Research and Development Division (Grand Ball Room)

G. A. DAY, Brown Co., Berlin, N. H., *General Chairman*

Statistics Committee—JOHN F. LANGMAID, JR., S. D. Warren Co., Cumberland Mills, Me., *Chairman*
Microbiological Committee—B. F. SHEMA, W. H. & L. D. Betz Co., Philadelphia, Pa., *Chairman*

Industrial Division (Grand Ball Room)

R. L. DAVIS, Scott Paper Co., Detroit, Mich., *General Chairman*

Nonfibrous Raw Materials Committee—E. N. POOR, Hudson Pulp & Paper Co., Augusta, Me., *Chairman*
Water Committee—A. S. ERSPAMER, Hollingsworth & Whitney Co., Waterville, Me., *Chairman*
Fibrous Agricultural Residues Committee—S. I. ARONOVSKY, Northern Regional Research Laboratory, Peoria, Ill., *Chairman*
Structural Fibrous Materials Subcommittee—R. G. LACEY, The Celotex Corp., Marrero, La., *Chairman*

Converting and Consuming Division (East Ball Room)

F. D. LONG, Container Corp. of America, Chicago, Ill., *General Chairman*

Graphic Arts—C. A. MORTON, West Virginia Pulp & Paper Co., Chicago, Ill., *Chairman* (155 E. 44th St.)
Coating Committee—R. T. TRELFA, Watervliet Paper Co., Watervliet, Mich., *Chairman*
Wet Strength Committee—K. W. BRITT, Scott Paper Co., Chester, Pa., *Chairman*
Plastics Committee—R. T. NAZZARO, Westfield River Paper Co., Russell, Mass., *Chairman*
Corrugated Containers Committee—BURT MENDLIN, Cornell Paperboard Products, Milwaukee, Wis., *Chairman*

Pulp Manufacture Division (Grand Ball Room)

R. I. THIEME, Scott Paper Co., Anacortes, Wash., *General Chairman*

Alkaline Pulping Committee—M. B. PINEO, Brunswick Pulp & Paper Co., Brunswick, Ga., *Chairman*
Mechanical Pulping Committee—F. W. O'NEIL, College of Forestry, State University of New York, Syracuse, N. Y., *Chairman* (Room G)
Chemical Products Committee—ARTHUR POLLAK, Consulting Engineer, New York, N. Y., *Chairman*
Pulp Purification Committee—W. H. RAPSON, University of Toronto, Toronto, Ont., *Chairman*
Acid Pulping Committee—N. S. LEA, Scott Paper Co., Everett, Wash., *Chairman*
Semichemical Pulping Committee—J. N. MCGOVERN, Parsons & Whittemore, New York, N. Y., *Chairman*
Paper Deinking Committee—J. J. FORSYTHE, International Paper Co., Niagara Falls, N. Y., *Chairman*
Pulp for Chemical Conversion—F. A. SIMMONDS, Forest Products Laboratory, Madison, Wis., *Chairman*

Paper Manufacture Division (Grand Ball Room)

H. C. MOORE, Beloit Iron Works, Beloit, Wis., *General Chairman*

Preparation of Papermaking Materials Committee—F. S. KLEIN, Byron Weston Co., Dalton, Mass., *Chairman*
Cylinder Board Committee—GLEN T. RENEGAR, Containe Corp. of America, Manayunk, Pa., *Chairman*
Fourdrinier Committee—N. R. PHILLIPS, Riegel Carolina Corp., Acme, N. C., *Chairman*

Testing Division (West Ball Room)

J. P. CASEY, A. E. Staley Mfg. Co., Decatur, Ill., *General Chairman*

Nonfibrous Materials Testing Committee—K. H. WILLIAMS, Mid-States Gummed Paper Co., Chicago, Ill., *Chairman*
Pulp Testing Committee—F. E. CASKEY, Morden Machine Co., Portland, Ore., *Chairman*
Optical Properties Committee—H. E. OBERMANNS, Hammermill Paper Co., Erie, Pa., *Chairman*
Microscopy Committee—C. E. BRANDON, Howard Paper Mills, Dayton, Ohio, *Chairman*
Paper Testing Committee—D. H. NEWCOMB, Riegel Paper Corp., Hughesville, N. J., *Chairman*
Chemical Methods—A. S. O'BRIEN, Eastman Kodak Co., Rochester, N. Y., *Chairman*
Wax Testing—W. J. YATES, Shell Oil Co., New York, N. Y., *Secretary* (Room A)

Note: Reports by all committee chairmen of the Testing Division will be given at this session.

Engineering Division (Room B-C)

J. D. LYALL, Armstrong Cork Co., Lancaster, Pa., *General Chairman*

Steam and Power Committee—W. M. WYBURN, Federal Paper Board Co., Bogota, N. J., *Chairman*
Chemical Engineering Committee—L. C. JENNESS, University of Maine, Orono, Me., *Chairman*
Corrosion Committee—S. J. BAISCH, Thilmany Pulp & Paper Co., Kaukauna, Wis., *Chairman*
Mill Maintenance & Materials Committee—L. L. MRACHEK, Mead Corp., Kingsport, Tenn., *Chairman*
Mill Planning and Economics Committee—P. A. FORNI, Mohawk Paper Mills, Troy, N. Y., *Chairman*

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Engineering Research and Machine Design Committee—R. G. Quinn, Johns-Manville Corp., Manville, N. J., *Chairman*
Electrical Engineering Committee—M. J. Osborne, Bowaters Southern Paper Corp., Calhoun, Tenn., *Chairman*
Data Sheets Committee—J. W. Hemphill, Johns Manville Corp., New York, N. Y., *Chairman*
Drying and Ventilating Committee—C. A. Young, Riegel Paper Corp., Milford, N. J., *Chairman*
Industrial Engineering and Materials Handling Committee—J. M. MacBrayne, Union Bag & Paper Corp., Savannah, Ga., *Chairman*

TUESDAY, FEBRUARY 22, 1955

9:00 a.m. Deinking (Room B-C)

J. J. Forsythe, International Paper Co., Niagara Falls, N. Y. *Chairman*

1. "Application of the Oliver-Ahlfors Screen to Deinked Stock," by A. C. Smith, Newton Falls Paper Mill, Inc., Newton Falls, N. Y. and F. Schorken, Dorr-Oliver, Inc., Stamford, Conn.
2. "Cleaning Deinked Stock with Centri-Cleaners," by J. L. Clouse, Oxford Miami Paper Co., West Carrollton, Ohio, and Ed. Rastatter, Bauer Bros. Co., Springfield, Ohio.
3. "The Use of Paper Stock," by H. J. Perry, Waste Paper Utilization Council, New York, N. Y.

9:15 a.m. Engineering (Grand Ball Room)

1. "The Sulzer System for Water Removal," by Robert Thomann, Sulzer Bros., Winterthur, Switzerland.
2. "Use of Paper in the Geodesic Pavillion," by R. B. Fuller, Forest Hills, N. Y.
3. "Modern Architecture in Pulp and Paper Mills," by Mario C. Celli, Celli-Flynn, McKeesport, Pa.

9:00 a.m. Wax Testing (Room A)

9:00 a.m. Mechanical Pulping Committee (Room G)

9:00 a.m. Chemical Methods (Room F)

9:00 a.m. Cylinder Board (West Ball Room)

Glen T. Renegar, Container Corp. of America, Manayunk, Pa., *Chairman*

1. "Stock Cleaning Systems," by P. S. Bolton, Robert Gair Co., Uncasville, Conn.
2. "Development of the Shartle Alligator Refiner," by H. P. Erspenmiller, Black-Clawson Co., Middletown, Ohio.
3. "Vat Exhauster Survey," by Otis Whitworth, Black-Clawson Co., Hamilton, Ohio.
4. "Optimum Use of Top Liner," by W. R. Csellak, Gardner Board & Carton Co., Middletown, Ohio.
5. "Weight and Caliper Control," by L. R. Ayers, Robert Gair Co., Piermont, N. Y.

9:00 a.m. Pulp Purification (East Ball Room)

W. H. Rapson, University of Toronto, Toronto, Ont., *Chairman*

Symposium—Chlorine Dioxide Bleaching

1. "Chlorine Dioxide and Safety," by J. F. Haller and W. W. Northgraves, Mathieson Chemical Corp., Niagara Falls, N. Y.
2. "Effect of Variables on Chlorine Dioxide Bleaching of Sulphate Pulp," by W. D. Harrison, *et al.*, Riegel Paper Corp., Milford, N. J.
3. Panel discussion by members from mills using chlorine dioxide.

9:00 a.m. Characteristics and Properties of Pulp Fibers (South Room)

James J. d'A. Clark, Longview, Wash., *Chairman*

12:30 p.m. Corrosion Committee (Luncheon)

2:00 p.m. Structural Fibrous Materials Committee (Room E)

2:00 p.m. Fundamental Research (Room B-3)

H. F. Lewis, Institute of Paper Chemistry, Appleton, Wis., *Chairman*

1. "The TAPPI-Sponsored Research Activity of the Fundamental Research Committee," by H. F. Lewis, Institute of Paper Chemistry, Appleton, Wis.
2. "The Research Appropriations Committee and Committee Projects," by John L. Parsons, Hollingsworth & Whitney, Waterville, Me.

   Report on TAPPI Research Projects 31 and 53 (University of Maine).
3. "Dye Adsorption of Wood Pulp, IV. Note on Effect of Drying of Pulp on Specific Dye Adsorption," by Edward F. Thode, Andrew J. Chase, and Yee Hu, University of Maine, Orono, Me.
4. "Correlation of Dye Adsorption and Cupriethylenediamine Viscosity Tests for Pulp Characterization," by Edward F. Thode and John F. Gorham, University of Maine, Orono, Me.

   Report on TAPPI Research Project 56 (Institute of Paper Chemistry, Appleton, Wis.).
5. "The Rheology of Cooked Wood, I. Introduction," by John Stone, Institute of Paper Chemistry, Appleton, Wis.
6. "Diffusion of Sodium and Ammonium-Base Neutral Sulphite Liquors into Wood," by J. E. Stone, and C. Förderreuther, Institute of Paper Chemistry, Appleton, Wis.

   Report on TAPPI Research Project 60 (University of Toronto, Toronto, Ont.).
7. "The Action of Water on Cellulose Between 100°C. and 225°C.," by B. B. Mithel, G. H. Webster, and W. H. Rapson, University of Toronto, Toronto, Ont.

   Report on TAPPI Research Project 62 (Forest Products Laboratory, Madison, Wis.).
8. "The Composition of Pulpwood Barks," by Ying Pe Chang and R. L. Mitchell, Forest Products Laboratory, Madison, Wis.

2:00 p.m. Pulp Purification (South Room)

W. H. Rapson, University of Toronto, Toronto, Ont., *Chairman*

Symposium—Peroxide Bleaching

1. "Commercial Application of Peroxide in the Bleaching of West Coast Kraft Pulps," by Walseth *et al.*, Weyerhaeuser Timber Co., Longview, Wash.
2. "Southern Pine Kraft Superbleaching with Hydrogen Peroxide on the Pulp Drying Machine," by M. B. Pineo and G. Seymour, Brunswick Pulp & Paper Co., Brunswick, Ga.
3. "Bleaching Northern Kraft with Peroxides," by R. E. Noreus and R. P. Hella, Northwest Paper Co., Cloquet, Minn.
4. Panel discussion by members from mills using peroxides.

2:00 p.m. Water (East Ball Room)

A. Thurn, Champion Paper & Fiber Co., Hamilton, Ohio, *Chairman*

1. "Determination of Carbon Dioxide by Conductivity Measurements," by C. A. Noll and J. W. Polsky, W. H. & L. D. Betz Co., Philadelphia, Pa.
2. "Slime Control Chlorination in Paper Production," by B. J. Twisdale, National Paper Corp. of Pennsylvania, Ransom, Pa.
3. "Water Pollution—Magnetic Abatement," by W. R. Stemen, *Chemical Abstracts*, Columbus, Ohio.
4. "Chemical and Biochemical Effluent Purification," by E. Farber and D. V. Robertson, Timber Engineering Co., Washington, D. C.

2:00 p.m. Cylinder Board (West Ball Room)

Glen T. Renegar, Container Corp. of America, Manayunk, Pa., *Chairman*

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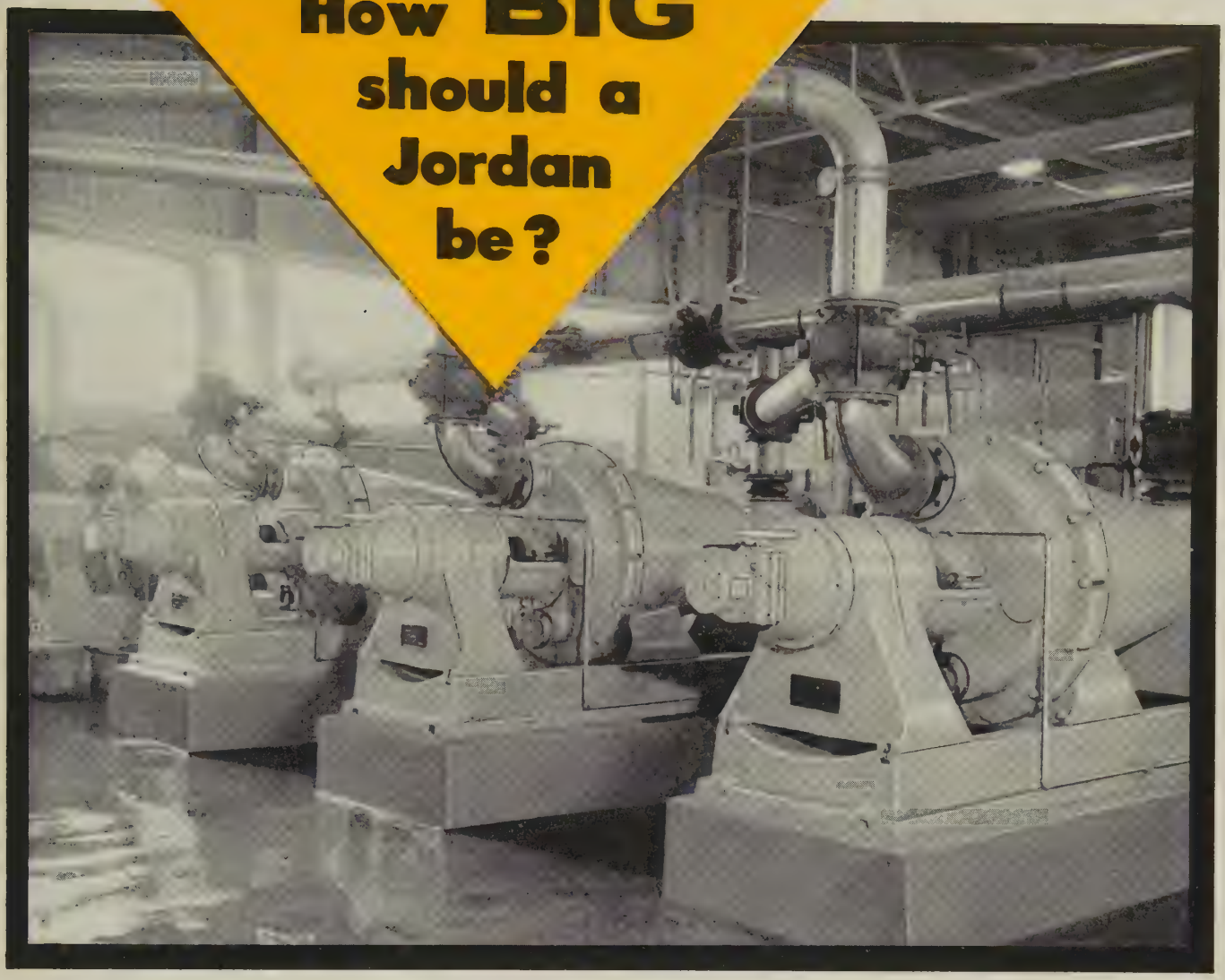

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6. "Use of Calender Driers and Smoothing Presses for Improving Finish," by J. J. Higgins, Ohio Boxboard Co., Rittman, Ohio.
7. Discussion of all papers presented.

2:00 p.m. Chemical Engineering and Corrosion (Grand Ball Room)

L. C. Jenness, University of Maine, Orono, Me., and S. J. Baisch, Thilmany Pulp and Paper Co., Kaukauna, Wis., *Co-chairmen*

1. "Properties and Analysis of Inorganic Pulping Solutions," by R. P. Whitney, S. T. Han, R. E. Kesler, and R. S. Couciere, Institute of Paper Chemistry, Appleton, Wis.
2. "Five Years Investigation of Digester Corrosion by the TAPPI Subcommittee," by J. R. Lientz, Union Bag & Paper Corp., Savannah, Ga., S. J. Baisch, Thilmany Pulp & Paper Co., Kaukauna, Wis., H. O. Teeple, International Nickel Co., New York, N. Y., and N. Shoumatoff, West Virginia Pulp & Paper Co., New York, N. Y.

3:30 p.m. Engineering Division (Grand Ball Room)

Meeting of Committee Chairmen and Secretaries.

WEDNESDAY, FEBRUARY 23, 1955

9:00 a.m. Semichemical Pulping (East Ball Room)

J. N. McGovern, Parsons & Whittemore, New York, N. Y., *Chairman*

1. "The Liquor to Wood Ratio as a Variable in NSSC Pulping," by E. L. Keller, U. S. Forest Products Laboratory, Madison, Wis., and J. N. McGovern, Parsons & Whittemore, New York, N. Y.
2. "Cohesive Rating in Semichemical Pulping," by John Hart, Pulp and Paper Research Institute of Canada, Montreal, Que.
3. "A Comparison of the Action of Sodium and Ammonium Neutral Sulphite Liquors on Wood Meal," by D. J. MacLaurin, J. E. Stone, and C. Förderreuther, Institute of Paper Chemistry, Appleton, Wis.
4. "The Recovery of Waste Liquors from NSSC Pulping by the Sulfox Process," by A. Pollak and R. S. Aries, Sulfox Corp., N. Y.

9:00 a.m. Dissolving Pulp (Room B-C)

F. A. Simmonds, U. S. Forest Products Laboratory, Madison, Wis., *Chairman*

1. "The Relationship of Tire Cord Properties to the Amount of Beta-Cellulose and Resistant Pentosan in the Pulp," by D. D. Bachlott, E. I. du Pont de Nemours & Co., Wilmington, Del.
2. "A Method of Qualifying Dissolving Grade Pulps," by B. G. Hoos, Brown Co., Berlin, N. H.
3. "Correlation of Accessibility of Cellulose with its Rate of Acetylation," by Elisabeth Barabash, A. J. Rosenthal, and B. B. White, Celanese Corp. of America, Summit, N. J.
4. "Studies on Use of Paper Chromatography in the Characterization of Dissolving Pulps," by J. F. Saeman, R. L. Mitchell, M. A. Millett, W. E. Moore, and R. C. Weatherwax, Forest Products Laboratory, Madison, Wis.

9:00 a.m. Statistics (South Room)

J. F. Langmaid, Jr., S. D. Warren Co., Cumberland Mills, Me., *Chairman*

Panel: Using Statistics in the Paper Industry.

1. Geoffrey Beall, Head, Department of Statistics, University of Connecticut, Storrs, Conn.
2. C. A. Bicking, Head, Experimental Design Section, Research and Development Div., Office Chief of Ordnance, Washington, D. C.
3. R. T. Trelfa, Technical Director, Watervliet Paper Co., Watervliet, Mich.

9:00 a.m. Preparation of Papermaking Materials (West Ball Room)

F. S. Klein, Byron Weston Co., Dalton, Mass., *Chairman*

1. "The Development of a New Stock Refining Process and Its Application to Cotton Linters," by E. H. Cumpston, S. D. Jones & Sons, Pittsfield, Mass.
2. "The Deculator-Cleaner," by J. C. Stewart and J. A. Smith, Rotareaed Corp., Bronxville, N. Y.
3. "The Electrokinetics of Rosin Size," by E. F. Thode, University of Maine, Orono, Me.
4. "A New Sizing Agent for Paper: Alkyl Ketene Dimers," by J. W. Davis, W. H. Robertson, and C. A. Weisgerber, Hercules Powder Co., Wilmington, Del.
5. "Algin Use in Board and Liner Manufacture," by A. L. Magnusson, Kelco Chemical Co., Chicago, Ill.

9:00 a.m. Corrugated Containers (Grand Ball Room)

W. D. Arburthnot, Fibre Board Container Corp., Richmond, Va., *Chairman*

1. "Variable-Speed Drive—Principal Advantages and Disadvantages," by F. A. Leser, Jr., Samuel M. Langston Co., Camden, N. J.
2. "The Use of Various Starches in Corrugating," by K. A. Wohl and P. Kaplan, Stein, Hall & Co., New York, N. Y.
3. "Research Project into Machine Design for New Corrugator," by W. Ward, F. X. Hooper Co., Glenarm, Md.

2:00 p.m. Dissolving Pulp (Room B-C)

M. O. Schur, Ecusta Paper Corp., Pisgah Forest, N. C., *Chairman*

Symposium—Filterability

1. "Laboratory Evaluation of Viscose Filterability with Different Filter Media," by L. N. Rogers, Buckeye Cotton Oil Co., Memphis, Tenn.
2. "The Influence of the Filter Medium on the Filtration of Viscose," by W. E. Davis, Hercules Powder Co., Wilmington, Del.
3. "Characterization of Pulps via Integrated Filtration and Optical Studies on Their Viscoses," by M. Golben, American Viscose Corp., Marcus Hook, Pa.
4. "Laboratory Preparation of Alkali Cellulose According to the Slurry Steeping–Continuous Shredding Process," by M. O. Schur and P. C. Muffat, Ecusta Paper Corp., Pisgah Forest, N. C.

2:00 p.m. Corrugated Containers (Grand Ball Room)

T. C. West, Southwest Corrugated Box Co., Fort Worth, Tex., *Chairman*

1. "Résumé of Printer-Slotter Questionnaire," by D. P. McNelly, Fort Wayne Corrugated Paper Co., Rochester, N. Y.
2. "Quality Control of Raw Materials," by Ked Martin, Fort Wayne Corrugated Paper Co., Rochester, N. Y.
3. "Printing Die Practices on Printer-Slotter," by A. Schmidt Commercial Stamping Co.
4. "Progress Report on Research into Printer-Slotter Creaser Profiles," by R. C. McKee, Institute of Paper Chemistry, Appleton, Wis.

2:00 p.m. Statistics (South Room)

J. F. Langmaid, Jr., S. D. Warren Co., Cumberland Mills, Me., *Chairman*

1. "Installing a Quality Control Program," by Joseph M. Juran, Consultant, 195 Beech St., Tuckahoe, N. Y.
2. "Statistical Quality Control in the Paper Industry," by L. C. Paulson, Statistical Control Supervisor, Minnesota and Ontario Paper Co., Minneapolis, Minn., and C. W. Carter, Rath and Strong, Boston, Mass.
3. "The Development of an Acceptance Plan for the Property-Thickness," by F. C. Hartwell, Quality Control Coordinator, Peter J. Schweitzer, Inc., Smith Paper Div., Lee, Mass.

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2:00 p.m. Papermaking (Fourdrinier)

N. R. Phillips, Riegel Carolina Corp., Acme, N. C., *Chairman*

1. "Some Viscoelastic Properties of Glassine," by R. T. Nazzaro, W. J. Brand, and S. R. Arnold, Westfield River Paper Co., Russell, Mass.
2. "Warehousing Shipping and Materials Handling of Carton Packed Papers," by S. W. Blanchard, Mead Corp., Chillicothe, Ohio.
3. "Remote Control Edge Alignment," by P. W. Jacobsen, H. G. Weber & Co., Kiel, Wis.
4. "Maintenance Cleaning with Chemicals," by L. B. Wilson, Dowell, Inc., New York, N. Y.
5. "The Acumeter System for Handling Wet End Additives," by J. E. Ward, Nopco Chemical Co., Harrison, N. J.
6. "Far Infrared Heating in the Paper Industry," by W. L. Thomson, Edwin L. Wiegand Co., Pittsburgh, Pa.

2:00 p.m. Testing (West Ball Room)

J. P. Casey, A. E. Staley Mfg. Co., Decatur, Ill., *Chairman*

1. "The Analysis of Fillers in Paper by Spectrographic Methods," by Louis Block and John Lewis, Lowell Technological Institute, Lowell, Mass.
2. "The Determination of Starch in Paper," by B. W. Forshee, National Bureau of Standards, Washington, D. C.

3:30 p.m. Patents (West Ball Room)

F. Makara, New York, N. Y., *Chairman*

1. "Patent Office Practice," by F. Makara, New York, N. Y.
2. "Recent Court Decisions," by F. Makara, New York, N. Y.
3. "Technical Manpower and Technical Information," by T. T. Collins, National Container Corp., Jacksonville, Fla.

THURSDAY, FEBRUARY 24, 1955

9:00 a.m. Pulping (West Ball Room)

M. B. Pineo, Brunswick Pulp & Paper Co., Brunswick, Ga., and N. S. Lea, Soundview Paper Co., Everett, Wash., *Chairmen*

1. "An Investigation of the Accelerated Brightness Reversion of Bleached Slash Pine Kraft Pulp," by S. M. Rollinson, St. Marys Kraft Corp., St. Marys, Ga.
2. "The Use of Chemicals in Improving Southern Pine Timber Stands," by A. E. Griffiths, Ethyl Corp., New York, N. Y.
3. "Kraft Mill Odor Control," by J. Von Bergen, Airchem, Inc., New York, N. Y.
4. "Technical Data and Operating Figures from the Most Recent Kamyr Continuous Cooking Plants," by J. Richter, Kamyr, Inc., Hudson Falls, N. Y.
5. "Chemical and Heat Recovery with the Venturi Scrubber at Thilmany," by P. H. West, Thilmany Paper Co., Kaukauna, Wis.
6. "Total Pressures for the System: Sulphur Dioxide–Water," by F. L. Wells and R. H. MacClaren, Eastman Kodak Co., Rochester, N. Y.
7. "Reducing the Dirt Content of Unbleached Sulphite Pulp with Centri-Cleaners," by A. B. Gorham, Ontario Paper Co., Thorold, Ont.

9:00 a.m. Plastics-Paper Combinations (South Room)

R. T. Nazzaro, Westfield River Paper Co., Russell, Mass., *Chairman*

1. "Properties of Latex Films Loaded with Inert Pigments," by E. B. Osborne, R. D. Savata, and G. J. Antifinger, B. F. Goodrich Chemical Co., Avon Lake, Ohio.
2. "New Developments in the Manufacture of Organic and Inorganic Synthetic Filter Paper," by H. F. Arledter, Hurlbut Paper Co., South Lee, Mass.
3. "A Motion Picture Investigation of Polymer Latex Phenomena," by J. W. Vanderhoff, Dow Chemical Co., Midland, Mich.
4. "Factors Influencing the Gas and Vapor Transmission of Polymer Films," by V. T. Stannett, New York State College of Forestry, Syracuse, N. Y.
5. "The Use of Polyamide Resin Suspensoids as Protective Coatings for Paper," by W. F. Brown, University of Florida, Gainesville, Fla.
6. "Odor and Flavor Quality of Paper," by P. H. Kelly and L. C. Cartwright, Foster D. Snell, Inc., New York, N. Y.

9:00 a.m. Corrugated Containers (Grand Ball Room)

F. D. Long, Container Corp. of America, Chicago, Ill., *Moderator*

Panel—"Open Forum on Box Shop Problems"

W. F. Ward, F. X. Hooper Co., Glenarm, Md.
C. D. Nitchie, S. M. Langston Co., Camden, N. J.
R. A. Sherman, A. E. Staley Mfg. Co., Decatur, Ill.
C. F. Lovely, Philadelphia Quartz Co., Philadelphia, Pa.
E. B. Seeger, S. M. Langston, Camden, N. J.
J. C. Neuhauser, F. X. Hooper Co., Glenarm, Md.
H. Blacker, Blacker Printing Ink Co.
F. Lowry, Universal Corrugated Machinery Co.
J. Bliss, Bostitch, Inc., Westerly, R. I.
T. C. West, Southwest Corrugated Box Co., Fort Worth, Tex.
C. F. Skiner, American Boxboard Co., Grand Rapids, Mich.

9:00 a.m. Packaging Materials Testing (Room A)

Howard S. Gardner, Fibreboard Products, Inc., Antioch, Calif., *Chairman*

Symposium—Insect Resistance

1. "Insect Resistant Packaging—The Background of the Problem," by W. M. Van Horn, Institute of Paper Chemistry, Appleton, Wis.
2. "The Status of Federal Research on the Development of Insect-Resistant Packages," by H. Laudani and D. F. Davis, U. S. Dept. of Agriculture, Savannah, Ga.
3. "Insect Repellent Coatings for Multiwall Paper Bags," by K. A. Arnold, St. Regis Paper Co., Deferiet, N. Y.
4. "The Development of an Insect Resistant Folding Carton," by R. I. Rice, American Coating Mills Corp., Chicago, Ill.
5. "Pre-Mix Food Packages and Some Chemical Treatments to Reduce Penetration by Insects," by H. E. Gray, Dept. of Agriculture, Ottawa, Can.
6. "A Laboratory Test for the Evaluation of the Repellency to Stored-Products Insects of Chemically Treated Paper," by H. Laudani, D. F. Davis, and G. R. Swank, U. S. Dept. of Agriculture, Savannah, Ga.
7. "Some Factors Affecting the Laboratory Testing of Packages for Resistance to Boring Insects," by D. G. Edwards, Fibreboard Products, Inc., Antioch, Calif.

9:00 a.m. Microbiological (Room B-C)

B. F. Shema, W. H. & L. D. Betz Co., Philadelphia, Pa., *Chairman*

1. "Recent Developments in the Use of Chemical Treatments and Synthetic Fibers in Paper Machine Felts," by L. M. Woodside, Albany Felt Co., Albany, N. Y.
2. "Biological and Chemical Attack on Woolen Felts," by R. J. Purdy, Orr Felt and Blanket Co., Piqua, Ohio.
3. "Effect of Felt Design on Paper Machine Operation," by I. H. Peters, F. C. Huyck & Sons, Rensselaer, N. Y.

10:00 a.m. ASTM Committee D-23, Cellulose and Cellulose Derivatives (Room F)

12:45 p.m. Annual Luncheon

George H. Pringle, Mead Corp., Chillicothe, Ohio, *Presiding*

1. Address by Clarence Francis, director and formerly chairman of the board of General Foods Corp., New York, N. Y.
2. Presentation of the TAPPI Medal to Vance P. Edwardes, Consultant, Corinth, N. Y., by Clark C. Heritage, Weyerhaeuser Timber Co., Tacoma, Wash.

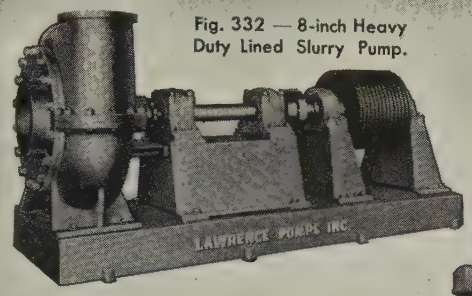


Fig. 332 — 8-inch Heavy Duty Lined Slurry Pump.

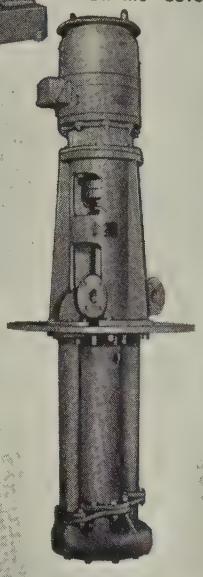


Fig. 244 — 4-inch Vertical Submerged Pump With No Bearings Below the Cover Plate.

Fig. 285 — 5-inch Vertical Top Suction Stock Pump.

Fig. 333 — 24-inch Horizontal Circulating Propeller Pump of Nickel Alloy Construction.

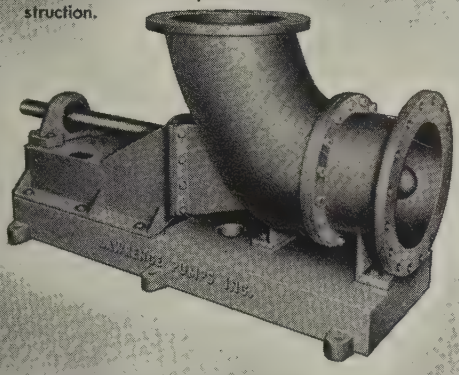
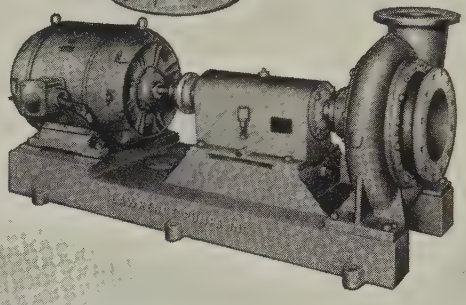


Fig. 337 — Lawrence 10-inch Heavy Duty Stainless Steel Chemical Pump.



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AMERICA'S DEMAND FOR WOOD, 1929–1975*

In the Summer of 1953, Weyerhaeuser Timber Co. retained Stanford Research Institute to study and report on the probable demand for all forest products through 1975, and the volumes of wood that need to be delivered to mills to meet those demands.

It became apparent promptly that the answers, when available, would be vitally interesting to other companies in the lumber, paper and pulp, plywood, and other forest industries. It also was apparent that the answers would be of interest to many observers outside the forest-products industries, including the United States Forest Service, which had its own projections to prepare in connection with the Timber Resource Review now under way.

In the Fall of 1953, the company announced that it would make the results of the Stanford study generally available. This report, which is a summary of the much longer report submitted by Stanford Research Institute, is in fulfillment of that commitment.

Those who have had experience with long-term projections know that seldom, if ever, do they come up with numbers that prove later to be precisely accurate. Undoubtedly before 1975 many of these projections will have required review.

We hope you will agree, however, after reading this report, that Stanford Research Institute has come up with an exhaustive and soundly reasoned analysis. The findings are strictly those of Stanford Research Institute, and not of Weyerhaeuser Timber Co.

These facts seem clear to us after reading this report:

1. **Bigger markets lie ahead, as a result of the expected growth in size and activity of the United States economy.**
2. **No part of the various forest-products industries has been immune from inroads by competing materials, and this competition will probably grow increasingly keen.**
3. **The various forest industries are already alert, and will be increasingly alert, to the possibilities of improved forestry and logging practices and new technical developments for harvesting the whole forest crop, and for using all the material that comes to the mills from that crop.**
4. **As competition and technical developments proceed, a larger volume of products will be made from about the same quantity of wood, so that available timber supplies will stretch much farther than would have seemed possible in the past.**

From here on, the words you read will be entirely those of Stanford Research Institute. We are pleased to pass its findings along to you, and we hope you will find them worth while.

Weyerhaeuser Timber Co.

ECONOMIC GROWTH OF THE UNITED STATES, 1952–1975

UNDERLYING the demand for forest products is the size of the national economy and the ability of the economy as a whole to purchase these materials.

No attempt is made in this study to forecast future short-period ups and downs of business activity; the concern is with long-term growth, size, and levels of the economy.

Logical steps in analyzing the prospects for long-term growth of the United States economy were:

1. Population, in total and by age groups.
2. Labor force, in total and by age groups.
3. Employment and the division of workers between private and public, and between military and civilian, employment.
4. Average hours of work per week (or per year).
5. Production per hour of work, in terms of gross national product (at 1952 prices).
6. Gross national product (GNP), or the market value of all goods and services produced. This is calculated from the expected number of people working, their average hours of work, and their average production per working hour.

Based on the estimated GNP, the following two series were estimated: (1) disposable personal income payments to individuals (the portion of national product left to individuals, after taxes, for spending or saving); and (2) industrial production, a measure of activity in the manufacturing and mining segments of the economy.

Table I records these figures from 1929 through 1952, and the projections for 1960, 1965, 1970, and 1975, that will be used throughout this report as the economic framework for projections for individual industries and products. Intervening years are interpolated only for clarity in graphic presentation; there is no attempt to predict business cycles as such. In Table I, as throughout the report, all dollar amounts are in terms of 1952 price levels.

This economic framework and other findings of this study are based on these general assumptions:

1. There will be no all-out war during the period covered by this study; however, a high level of military preparedness will continue.
2. There will be no radical advances in technology to increase productivity at a higher rate than in the past.
3. There will be a greater degree of stability in business cycles in future years than in the past 25 years. This stability will be accompanied by high, but not full, employment.

The following general methods were used in arriving at the basic projections in Table I.

Population

The number of women of child-bearing age, by 5-year age groups, was projected by 5-year intervals. The number of births was projected on the basis that by 1975 birth rates for each age group of mothers will have declined at a slow and uniform rate to their 1946 levels. This assumes that special postwar influences

* The following text, which are the sections of primary interest to the pulp and paper industry, was taken from a summary of a report by the Stanford Research Institute, Stanford, Calif., to the Weyerhaeuser Timber Co., Tacoma, Wash.

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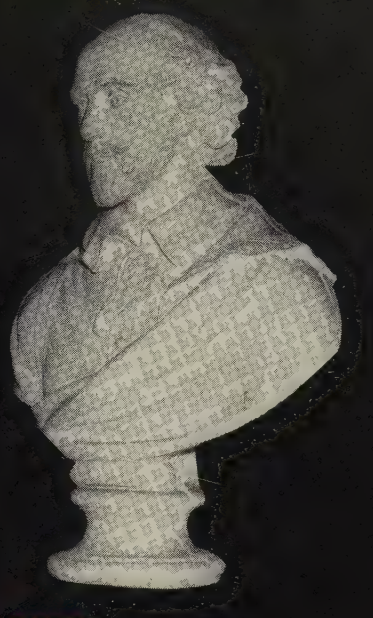

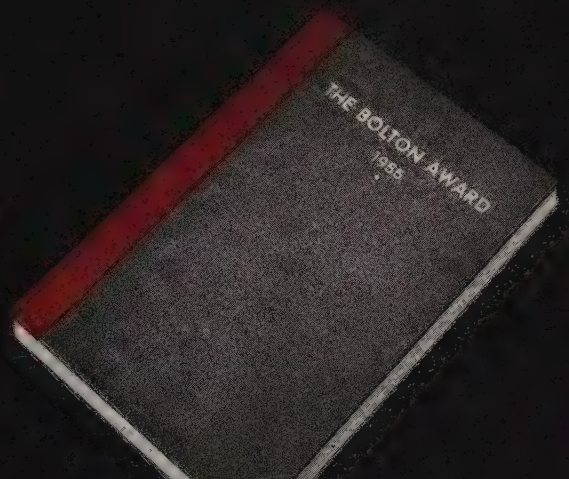

WHO?

All pulp and paper mill employees are eli gible to win one of the **three national prize** of $1,000, $750 and $500, or one of th **ten divisional** prizes of $100 each.

HOW?

By writing a paper on the subject, "**The Value of Better Mill Communications,**" o 1500 words or less, typed double spaced on 8½" x 11" sheets. Cover sheet only to include: name, name and location of mill and position or duties.

WHEN?

Now. All papers must be postmarked be fore midnight March 31, 1955. Mail to Secretary and Treasurer, The American Pulp and Paper Mill Superintendents Association, 327 So. La Salle St., Chicago 4, Illinois.

Annual Bolton Award Essay Contests are spon sored by **The American Pulp and Paper Mill Superintendents Association.** *The 13 prize winning papers are published in bound vol umes for free distribution "to foster an ex change of ideas on matters of common interest to all persons engaged in the pulp and paper industry."*

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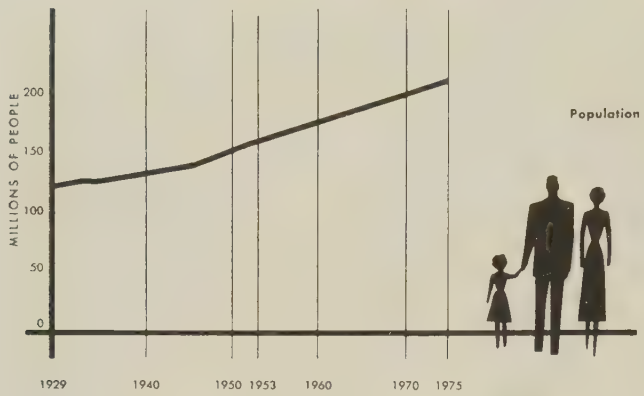
that have affected marriage and birth rates since 1946 will not continue.

The national death rate has been declining steadily for the past several decades, dropping from 17.2 deaths per thousand population in 1900 to 9.6 per thousand in



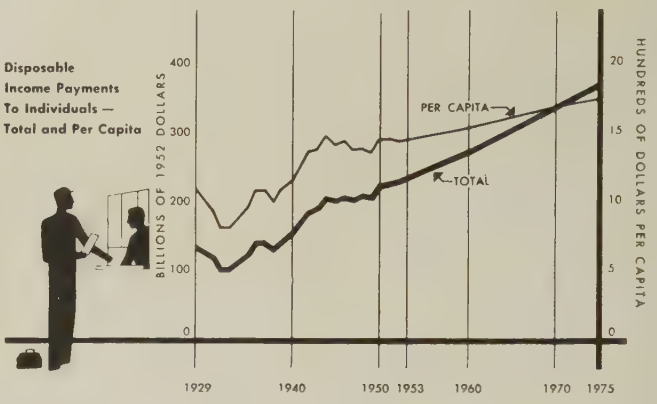
1950. It is expected that the trend toward longer life expectancy will continue in future years, but at a decreasing rate. The death rate for 1975 is estimated at about 8.8 per thousand.

Assuming immigration quotas will be essentially unchanged for the projection period, net immigration will probably remain at about 280,000 annually.

Alternative methods of estimating 1975 population produced results varying only slightly from the projection of 212 million used in this study.

Labor Force estimates are based on population estimates, and projected labor force participation rates by sex for various age groups published by the United States Bureau of the Census. Participation rates show a decline in the percentage of school-age persons in the labor force through 1975, a decline in the percentage of men over 65 in the labor force, and substantial increases in the percentage of women in the labor force in all age groups except the youngest (14 to 19 years). Women are expected to be 37.5% of the labor force in 1975, compared to 31.3% in 1950.

Future Employment estimates represent about 96% of the projected total civilian labor force. The percentage of government employees to total civilian employees is



expected to decline from 9.6% in 1952 to about 7% by 1975.

Estimated Gross National Product of $586 billion (at 1952 prices) in 1975 is the total of separate estimates of gross private product and gross public product. The

Table I. Indicators of the Size and Activity of the United States Economy, 1929–75

Year	*United States population* (1)	*Total labor force* (2)	*Civilian labor force* (3)	*Civilian employment* (4)	*Average weekly hours* (5)	*Gross private production per man-hour* (6)	*Gross national product* (7)	*Disposable income payments to individuals* (8)	*Index of industrial production* — *Durable* (9)	*Nondurable* (10)	*Total* (11)
1929	122	49.4	49.2	47.6	48.5	1.45	174	136	60	56	59
1930	123	50.1	49.8	45.5	47.0	1.42	158	126	45	51	49
1931	124	50.7	50.4	42.4	47.0	1.41	146	118	31	48	40
1932	125	51.2	51.0	38.9	45.3	1.36	125	101	19	42	31
1933	126	51.8	51.6	38.8	46.0	1.33	124	102	24	48	37
1934	126	52.5	52.2	40.9	44.2	1.44	138	111	30	49	40
1935	127	53.2	52.9	42.3	43.5	1.54	150	120	38	55	47
1936	128	53.7	53.4	44.4	44.2	1.62	170	138	49	61	56
1937	129	54.3	54.0	46.3	44.9	1.63	178	139	55	64	61
1938	130	55.0	54.6	44.2	43.1	1.68	170	130	35	57	48
1939	131	55.6	55.2	45.8	43.7	1.76	185	141	49	66	58
1940	132	56.0	55.6	47.5	43.4	1.87	202	149	63	69	67
1941	133	57.4	55.9	50.4	43.7	2.02	234	167	91	84	87
1942	135	60.2	56.4	53.8	45.1	2.04	262	183	126	93	106
1943	137	64.4	55.5	54.5	46.2	2.14	295	188	162	103	127
1944	138	65.9	54.6	54.0	45.9	2.31	318	202	159	99	125
1945	140	65.1	53.8	52.8	44.5	2.38	310	198	123	96	107
1946	141	60.8	57.5	55.2	42.8	2.26	280	202	86	95	90
1947	144	61.6	60.2	58.0	42.4	2.21	280	198	101	99	100
1948	147	62.7	61.4	59.4	42.3	2.25	290	203	104	102	104
1949	149	63.6	62.1	58.7	41.5	2.33	291	201	95	99	97
1950	152	64.6	63.1	60.0	41.8	2.46	316	219	116	111	112
1951	154	65.8	62.9	61.0	41.1	2.61	338	222	128	114	120
1952	157	67.4	63.0	61.3	41.7	2.64	348	224	136	114	124
1960	176	72.3	69.8	66.7	40.1	3.01	412	268	163	141	151
1965	187	77.6	75.1	72.2	39.1	3.24	465	298	189	159	172
1970	199	83.9	81.4	78.0	38.1	3.46	527	333	221	179	198
1975	212	90.7	88.2	84.4	37.1	3.65	586	367	251	198	222

Sources and description of data: Col. (1), U. S. Bureau of Census; millions, continental U. S. plus armed forces overseas. Col. (2) and (3), U. S. Bureau of Census; millions. Col. (4), U. S. Dept. of Commerce, *Business Statistics Supplement* to the *Survey of Current Business*, 1953; millions. Cols. (5) and (6), derived from U. S. Dept. of Commerce and U. S. Dept. of Agriculture data; gross private production per man-hour is in dollars at 1952 prices. Cols. (7) and (8), U. S. Dept. of Commerce; billions of dollars at 1952 prices. Cols. (9), (10), and (11), *Federal Reserve Bull.*, December, 1953; Index, 1947–49 = 100. All projections by Stanford Research Institute.

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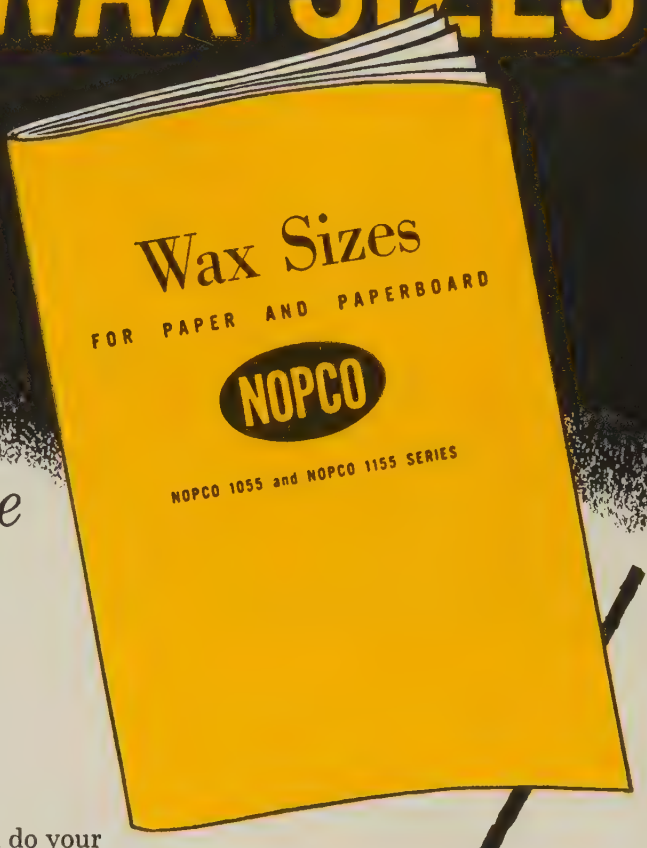

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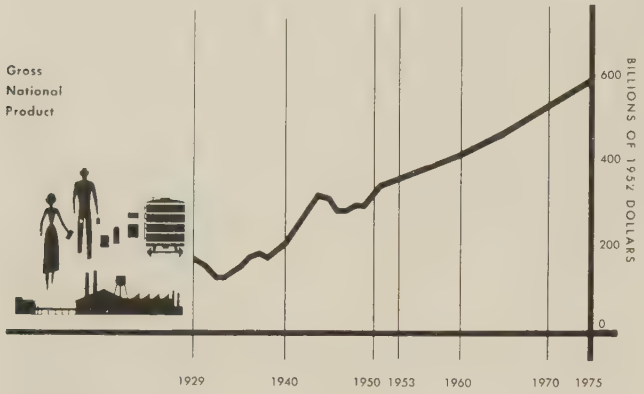
former is the product of gross private product per man-hour and annual hours worked by civilians employed outside of government. The latter is the product of gross public product per man-hour and annual hours worked by government employees.



Other methods used to project GNP levels provided reassuringly close results.

Real Disposable Income Payments to Individuals proved in most cases to be the best income indicator in explaining past changes in product demands to be estimated. Moreover, it is the only series available by states, so it can be used to compute regional demand.

Industrial Production estimates (Federal Reserve Board Index) used in this study were derived from the past correlation between this index and GNP at 1952 prices.

FACTORS AFFECTING THE LONG-RANGE DEMAND, SUPPLY, AND PRICE OF FOREST PRODUCTS

By 1975, three forest products—lumber, pulp, and plywood—are expected to take 90% of total wood requirements, including all sizes and grades of material, and 95% of sawlog-size wood.

Because each of these forest products actively competes in each of its markets with many other materials, the future level of forest-products consumption in the United States will depend to a large extent on the prices of forest products in relation to the prices of competing materials. Estimates of future forest-products consumption without regard to price are meaningless. This is a study of probable market demand for forest products, not of what people might like to have, or of what someone thinks are the nation's needs.

Much of the demand for these forest products, or materials competing with them, stems from three principal fields: construction, shipping materials, and manufactured products.

Future forest-products market demand will depend on the level of activity in these major markets, on the available supply of forest products and the cost of making them, on the relationship between the price of each forest product and the prices of competing materials, and on changes in technology and consumer acceptance.

Long-Range Outlook for Construction

Table II shows expenditures (at 1952 prices) for major types of new construction in the United States from 1929 through 1952, with projections for 1960, 1965, 1970, and 1975. These projections are based on the past relationships between construction expenditures, population, and GNP.

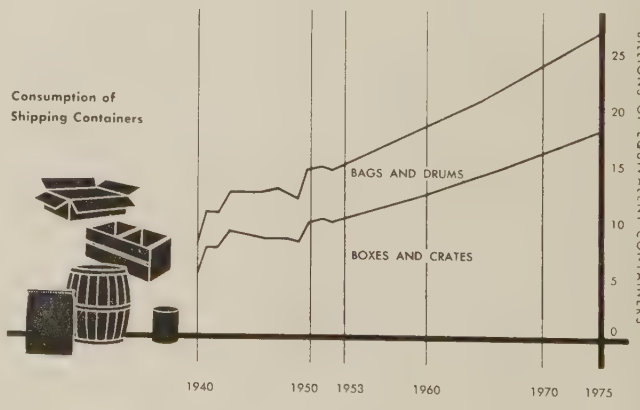
Within the industrial, commercial, and public utility group, a rise in public utility expenditures is expected to overbalance a substantial reduction in government expenditures for atomic energy facilities and other industrial plants.

The increase in the schools, hospitals, and institutions classification is primarily for school buildings, reflecting a 56% increase in school-age population between 1950 and 1975.

The outlook for residential construction activity can also be seen in terms of the expected number of housing starts. The projection of nonfarm housing starts is based on past relationships between new nonfarm housing starts and total population, annual changes in population, levels of real disposable income and trend. Farm housing starts are projected on the basis that the number of farms is likely to decline by about 10,000 per year to 1975, but the number of dwelling units† per farm is expected to increase from the 1.2 of 1950 to 1.3 by 1975 as farms become larger and the population per farm (including hired hands) increases. Taking into account past replacement rates of farm dwelling units, the following projections of new housing starts result:

	Nonfarm	*Farm*	*Total*
1960	1,320,000	85,000	1,405,000
1965	1,470,000	85,000	1,555,000
1970	1,650,000	85,000	1,735,000
1975	1,860,000	85,000	1,945,000

Replacement of existing units may possibly account for a growing portion of projected housing starts, ranging from about 500,000 housing units per year in the late 1950's to about 700,000 by 1975. Replacement does not imply one house literally being torn down and another erected in its place. Rather a replaced housing unit may be torn down, stand vacant



for an indefinite period, or be converted to some nonhousing use; the unit replacing it will normally be built elsewhere. A high rate of replacement may be reflected in higher vacancy ratios than have been customary in the past.

† Dwelling unit: a separate residential unit with cooling facilities, whether in single houses or apartment-type structures.

Pulp digesters to improve the quality of tires

Installed in new plant to produce Chemical cellulose for Rayon cord

This is one of six, four SMITHlined and two clad digesters made by A. O. Smith for the new Rayonier Incorporated, Jesup Division installation.

It will produce chemical cellulose for rayon cord that will form casings for more economical, longer lasting automobile tires.

Lined with type 316 ELC stainless steel, these digesters are 12 feet in diameter, 55 feet high and are completely shop fabricated at our Milwaukee works.

A. O. Smith engineers have worked closely with Rayonier in the past. They assisted in designing, and built the world's largest digester for their Fernandina division, and supplied two for the Port Angeles, Washington, mill.

Now, when building a new plant, Rayonier comes, again, to A. O. Smith for digesters.

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If you are faced with corrosion problems arising from the use of pulping chemicals in digesters, we shall be pleased to assist you in solving them.

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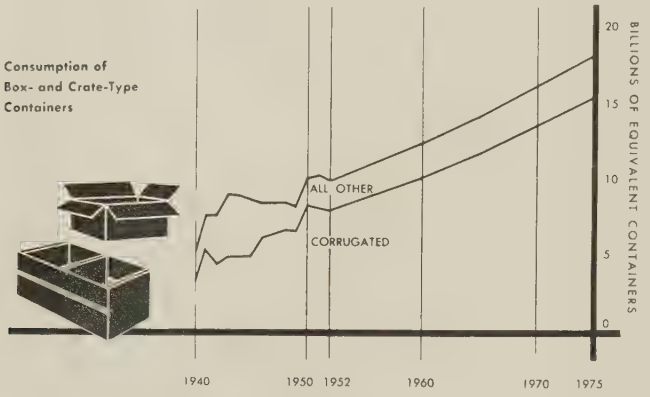
In addition to new permanent starts, the housing supply is augmented by trailers and conversions (dwelling units built in structures formerly nonresidential, as well as additional units constructed in existing residential structures).



Annual net trailer additions to the housing inventory may well be reduced from 45,000 in 1950 to about 3000 in 1975, coincident with a drop in the proportion of trailers used for housing. By 1975, the bulk of trailer production for residential use is expected to be for replacement.

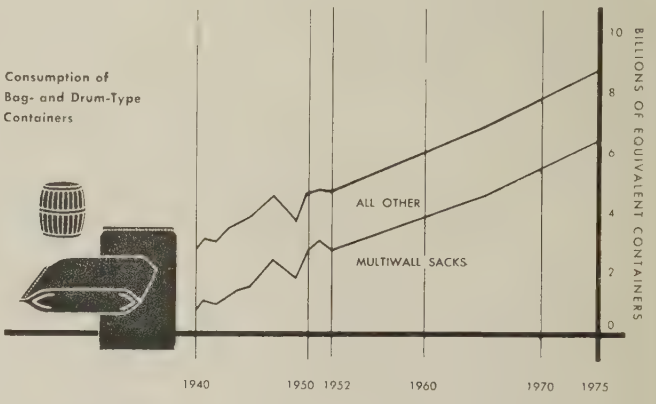
Additional housing units made available by conversion are offset in part by "negative conversions"—changing housing units to nonresidential uses. Net conversions may decline from around 200,000 per year currently to about 100,000 per year by 1975.

Long-Range Outlook for Shipping Materials

Shipping containers, as distinguished from packaging materials such as boxboard and glass, can be divided generally into two main groups:

1. The box and crate-type, used primarily for shipping packaged goods and finished and semifinished products, and
2. The bag and drum-type, used primarily for materials shipped in liquid or bulk form.

To determine past changes in demand for shipping containers, the various materials used in each group were converted to the number of equivalent containers of a standard size ($1^1/_2$ by 1 by 1 ft.) producible annually. Allowing for the average weight of each type of material, as well as for such parts as flaps on fiberboard containers, the number of equivalent containers was calculated for each year from 1940 through 1952.



Production of both container types fluctuates in the same proportion as changes in industrial activity, as measured by the Federal Reserve Board Index of Industrial Production. Total demand for shipping containers of both types is expected to increase by 85%

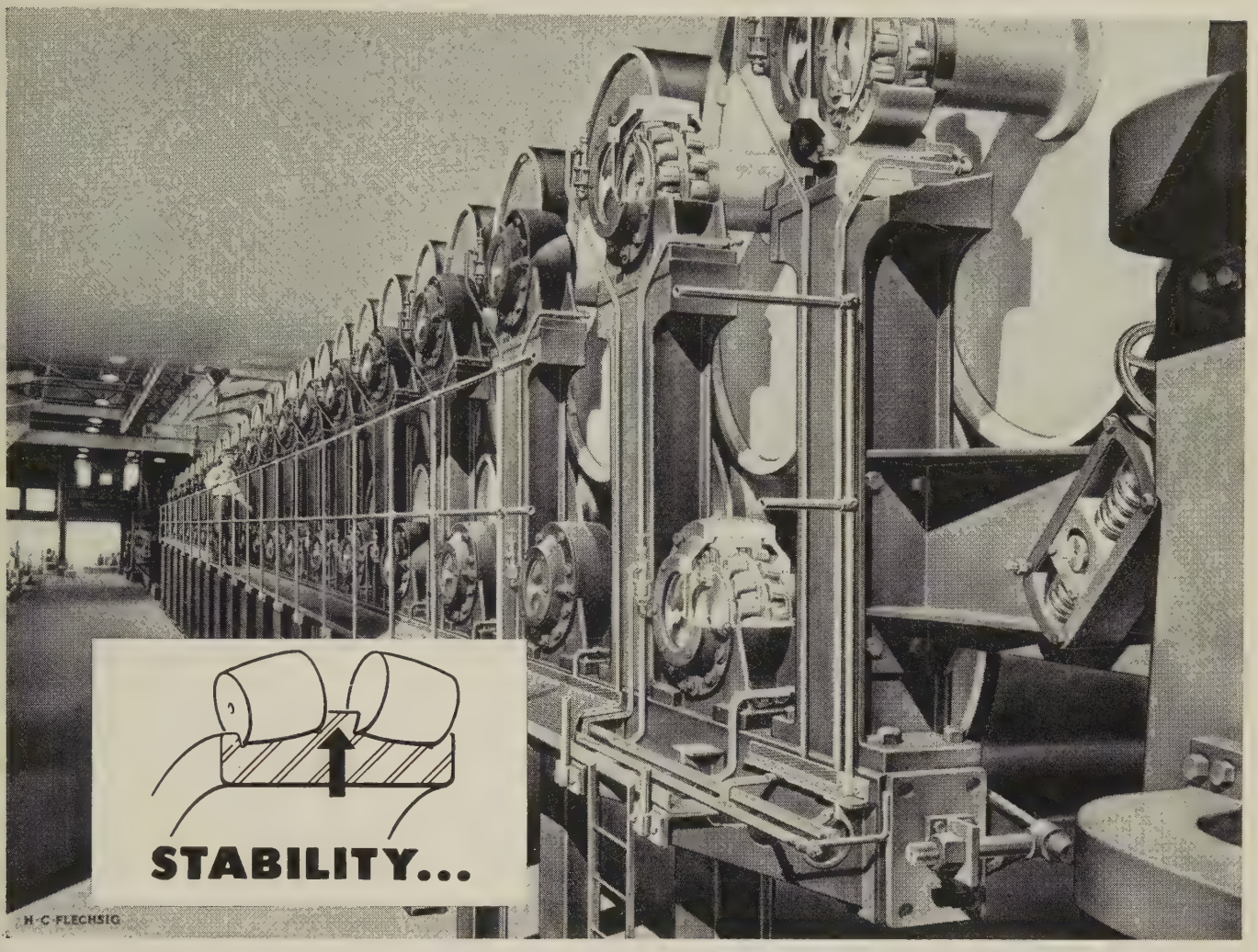
Table II. New Construction Expenditures, 1929–75

Billions of 1952 dollars

Year	*Nonfarm residential*	*Industrial, commercial, and public utility*	*Schools, hospitals, and institutions*	*Highways*	*Military and naval*	*Other non-residential*[a]	*Total non-residential*[a]	*Total new construction*
1929	8.8	8.3	1.6	3.0	0.0	3.6	16.5	25.3
1930	5.2	6.9	1.7	3.6	0.1	3.8	16.1	21.3
1931	4.2	4.2	1.6	3.6	0.1	3.4	12.9	17.1
1932	2.1	2.4	0.8	3.0	0.1	2.5	8.8	10.9
1933	1.4	1.7	0.5	2.2	0.1	2.2	6.7	8.1
1934	1.8	1.8	0.8	2.5	0.1	2.4	7.6	9.4
1935	3.0	2.1	0.7	2.1	0.1	3.1	8.1	11.1
1936	4.7	2.7	1.2	3.5	0.1	4.3	11.8	16.5
1937	5.1	3.9	0.9	2.8	0.1	3.8	11.5	16.6
1938	5.1	2.8	1.2	3.3	0.1	4.0	11.4	16.5
1939	6.8	3.2	1.7	3.4	0.2	4.3	12.8	19.6
1940	7.6	4.1	0.7	3.1	1.0	3.9	12.8	20.4
1941	8.7	7.5	0.7	2.4	3.6	3.5	17.7	26.4
1942	4.7	9.2	0.6	1.3	9.8	2.1	23.0	27.7
1943	3.3	4.8	0.4	0.7	4.8	1.5	12.2	15.5
1944	1.9	4.1	0.4	0.7	1.5	1.3	8.0	9.9
1945	2.1	4.3	0.4	0.7	1.3	1.4	8.1	10.2
1946	6.8	6.7	0.6	1.4	0.3	3.0	12.0	18.8
1947	8.3	6.4	0.9	1.9	0.3	3.7	13.2	21.5
1948	10.0	6.7	1.4	2.2	0.2	4.7	15.2	25.2
1949	10.3	6.3	2.5	2.4	0.1	5.3	16.6	26.9
1950	14.5	6.6	2.5	2.7	0.2	6.0	18.0	32.5
1951	12.1	8.5	2.8	2.6	0.9	5.4	20.2	32.3
1952	11.8	9.0	2.7	2.9	1.4	4.5	20.5	32.3
1960	13.6	8.0	3.2	3.4	0.7	6.1	18.9	32.5
1965	15.0	8.7	4.1	3.7	0.6	6.3	20.5	35.5
1970	17.7	9.8	4.7	4.6	0.6	6.9	23.3	41.0
1975	19.5	10.8	5.1	5.0	0.5	7.8	25.3	44.8

Source: Actual—U. S. Dept. of Commerce; Projections by Stanford Research Institute.
[a] Includes farm residential.

TORRINGTON *Spherical Roller Bearings installed in drier section of Gibraltar Corrugated Paper Cylinder board machine. Drawing—Courtesy of Socony-Vacuum Oil Co., Inc.*



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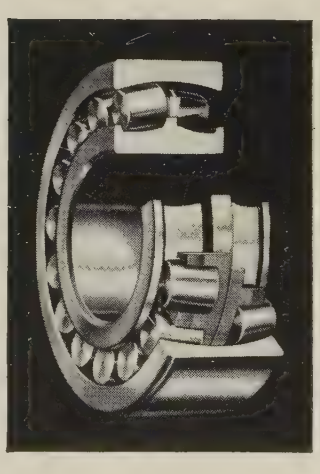
are designed with integral center flange on inner race to provide positive radial stability and positioning for thrust loads



This center flange guides the rollers accurately and friction is reduced to a minimum.

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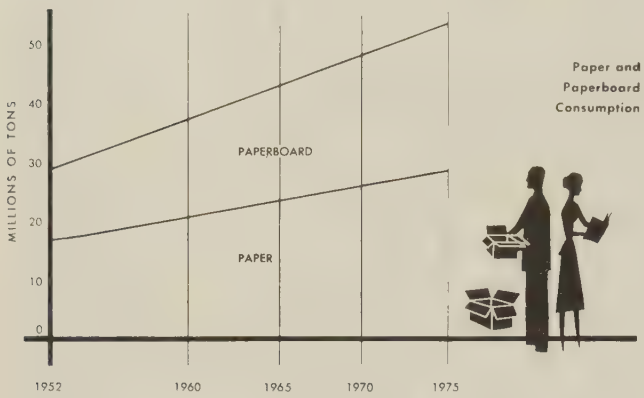
between 1952 and 1975. Competitive shifts of various materials within each shipping-container type from 1940 through 1952, and the expected further shifts from 1952 to 1975, are shown in Table III.

In general, box and crate-type containers take two



thirds of the total shipping container market. Within this group, corrugated containers have increased their share from 67% in 1940 to nearly 80% in 1952, and they are expected to be 85% of the total by 1975. The rise in corrugated containers, due primarily to their light weight and low cost, has been chiefly at the expense of wooden boxes.

Similarly, in bag and drum-type containers, multi-

of pallets by industry, begun in the 1930's, received it first big push during World War II, when several million pallets were produced. Advantages of palletization were soon apparent—reduced labor costs, expeditious handling and delivery of goods, and optimum utilization of storage and transport space.

The most common material used in manufacturing pallets is lumber, although steel, paperboard, plywood, aluminum, and combinations of these have been tried.

Based on increases foreseen in industrial activity, pallet production is expected to rise from about 33 million in 1952 to about 68 million by 1975. Pallets made of lumber are expected to decline as a percentage of total production. Output of lumber pallets, therefore, is expected to increase only from 32 million in 1952 to 51 million by 1975.

Long-Range Outlook for Forest Products in Manufacturing

Although forest products are used in a wide variety of manufactured products, the furniture and fixtures industry is most important, representing almost half the current consumption of lumber in all manufactures. Other large users are the railroad car and motor vehicle industries.

Furniture and fixtures shipments are expected to increase from $3110 million in 1952 to $6090 million by 1975. Household furniture expenditures are expected to rise from $2351 million in 1952 to $4730 million by 1975, and commercial, professional, and public building

Table III. Total United States Consumption of Shipping Containers by Type, 1940–75

(Millions of equivalent containers 1 1/2 by 1 by 1 ft.)

	Box and crate type					*Bag and Drum type*								
Year	*Corrugated*	*Solid fiber*	*Wood*	*Plywood and veneer*	*Total box and crate type*	*Multi-wall sacks*	*Cotton sacks*	*Burlap bags*	*Steel drums and pails*	*Slack cooperage*	*Tight cooperage*	*Fiber drums*	*Total bag and drum*	*Grand total*
1940	3,800	250	1250	300	5,600	700	900	700	100	200	100	[a]	2700	8,300
1941	5,300	300	1550	350	7,500	1000	1000	700	200	200	100	[a]	3100	10,600
1942	4,250	400	2500	350	7,500	900	1300	300	200	200	100	[a]	3000	10,500
1943	4,800	450	3400	350	9,000	1100	1400	400	300	100	100	[a]	3400	12,400
1944	4,700	500	3250	350	8,800	1400	1100	600	200	100	100	[a]	3600	12,400
1945	4,800	500	3000	300	8,600	1500	1000	900	200	100	100	[a]	3800	12,400
1946	6,050	250	1600	400	8,300	2000	800	1000	200	100	100	[a]	4200	12,500
1947	6,300	250	1450	300	8,300	2400	800	900	200	100	100	[a]	4500	12,800
1948	6,500	250	1250	300	8,300	2000	700	900	200	200	[a]	[a]	4100	12,400
1949	6,450	200	1100	350	8,100	1800	700	800	200	100	[a]	[a]	3700	11,800
1950	8,150	250	1150	450	10,000	2700	600	800	300	100	[a]	100	4600	14,600
1951	7,950	300	1350	500	10,100	3000	600	600	300	100	[a]	100	4700	14,800
1952	7,800	250	1250	500	9,800	2700	600	900	300	100	[a]	100	4700	14,500
1960	10,000	250	1400	650	12,300	3800	600	1000	300	100	[a]	200	6000	18,300
1965	11,700	250	1400	750	14,100	4500	500	1000	400	100	[a]	300	6800	20,900
1970	13,500	250	1500	850	16,100	5400	500	1000	400	100	[a]	400	7800	23,900
1975	15,300	200	1550	950	18,000	6300	400	1000	400	100	[a]	500	8700	26,700

Sources: Actual derived from U. S. Dept. of Commerce data by Stanford Research Institute. Projections by Stanford Research Institute.
[a] Less than 50 million equivalent containers.
Note: Detail may not add to total, due to rounding.

wall paper sacks have increased their share from 25% in 1940 to nearly 60% in 1952, largely at the expense of cotton sacks. The share of multiwall sacks is expected to increase to about 72% of the bag and drum total by 1975. Fiber drums have also taken an increasing share of this market in recent years, and they will take more in the future. Steel drums and pails have accounted for a relatively stable share of the total, while tight cooperage has lost most of its markets except for whiskey storage.

Pallets afford another forest-products use. The use

furniture and fixtures expenditures to go from $759 million in 1952 to $1360 million by 1975. These estimates are based on past relationships between furniture and fixtures expenditures and levels of personal disposable income.

Total railroad freight car output is expected to drop from 78,000 in 1952 to about 57,000 by 1975, based on the estimated inventory required in that year together with the estimated average age of cars of each type. Of the freight car types most important to the forest-products market, automobile cars, boxcars, and gondola

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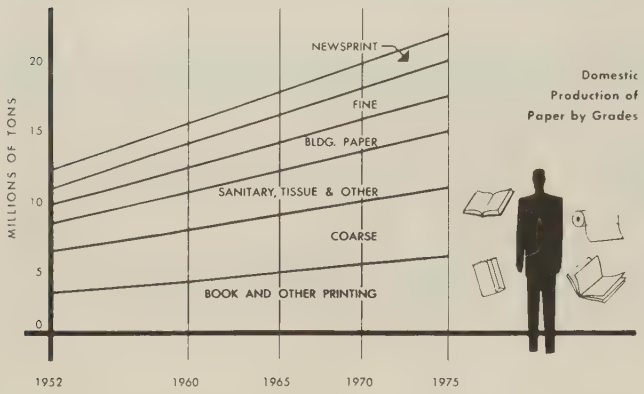
cars will probably account for more than 90% of total freight car production in 1975.

Output of trucks, truck-trailers, and busses is expected to increase about 70% between 1952 and 1975. Truck production is expected to increase from 1.2 million in 1952 to 2.1 million by 1975. These esti-



mates are based on the correlation of motor-vehicle production with population and real disposable income payments.

In summary, this review of the outlook for the major forest-products markets indicates major expansion by 1975 in most markets. Questions remaining are the prospective supply and price of forest products and their impact on the competitive position of the various forest products.

Prospective Supplies and Relative Prices of Forest Products

Lumber. One of the fundamental problems of the national lumber industry is the cost of producing sawlogs. Through 1975 these costs will probably increase to such an extent that resulting lumber prices will continue to increase relative to those of competing materials.

Among the reasons costs of producing sawlogs and lumber in the United States will probably continue to increase are:

1. Costs of stumpage (stands of merchantable timber) are likely to keep increasing as the supply of available and readily accessible timber is reduced. Much will depend on the amounts cut from government-owned timber, especially in the west, where almost two thirds of the commercial forestland is government-owned. These amounts cut from government-owned timber have been rising in recent years, but they are still well below the potential annual cuts consistent with sustained-yield management of the forests.
2. Logging costs are likely to rise as logging activity continues to shift to relatively remote areas or regions with rugged terrain, involving more difficult operations and higher log-transportation costs. The logging of lands with less volume per acre, and the declining size of trees being cut in all regions will also raise logging costs.
3. Manufacturing costs will probably be increased by the declining size of logs, rising labor costs (especially in the South), and an increased proportion of output from small, relatively high-cost mills as mill locations are adapted to scattered timber supplies.
4. Distribution costs, which represent about two thirds of the cost of lumber to the consumer, will probably also increase. Transportation is a large part of this cost. The higher transportation cost to eastern markets for western lumber (which now accounts for more than 60% of domestic softwood lumber production), as compared with southern lumber, will tend to increase average lumber prices in coming years.

It is expected that annual U. S. lumber production will be moderately upward through 1975, increasing from the 1952 level of about 38.2 to about 41 billion board ft. by 1975.

In the production of this quantity of lumber, the relative position of the west is estimated to continue to rise as it has in recent years, accompanied by a relative decline in the south, and little change in the east's relative position.

Considerable progress has been made during the past several years in placing the nation's timberland on a sustained-yield basis. In the south, however, there is only limited evidence that small producers, who account for the major portion of total lumber production (as distinguished from pulp production), have made provision for future large-scale sawtimber supplies.

This outlook for the next 20 years is strongly influenced by the fact that two thirds of the present sawtimber cut is in the west. If a projection were made to the year 2000, the fact that the area east of the Rocky Mountains contains three fourths of the forestland, as well as more than four fifths of the population, would serve to temper the importance of the west over the longer period. It may be that the last quarter of the century will be marked by lumber production shifts opposite to those suggested for the next 20 years in this study, depending upon policies for timber restocking, forest management, and allocation of wood resources (as between lumber and pulp) followed in the south.

Another possible source of supply is from foreign countries and Alaska. If enough imports of sawlogs and lumber could be made available at prices competitive with substitute materials, the timber industry's problem in meeting short-term demand would be solved.

Of the estimated 10 billion acres of forestland in the world, about 23% is in the USSR, 23% in Africa, 12% in Asia, 19% in South America, 19% in North and Central America, and only about 3% in Europe. The world supply of softwood lumber is about a third of total supply in the productive forest areas, the only major softwood regions being in the United States, Canada, and the USSR.

Although North and Central America and Europe together contain only about 30% of the world's forestland outside the USSR, they accounted in 1951 for almost 80% of the world production of roundwood (again excluding the USSR). This indicates large quantities of the world supply are "inaccessible"—that is, even at the present high level of world prices for lumber and sawlogs, it has not been economically feasible for those countries with large wood supplies to produce much for the world market. Potential supplies in South America and Africa probably will not be harvested and transported to the United States in large quantity unless the relative price of lumber increases more rapidly than is expected in the coming 20 years.

Increasing demand levels in both North America and Europe will tend to reduce their interchange of timber products in the next 20 years. Probably the increase in European wood demand will be met largely by Sweden, Finland, and perhaps the USSR, and wood for export to the United States will be at prices relatively high compared to North American supplies.

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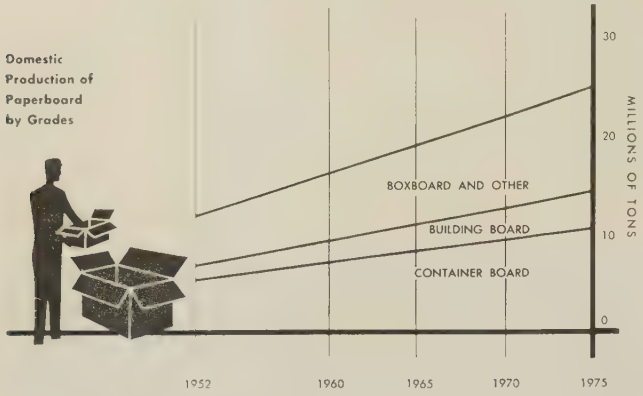
A considerable increase in the price of domestic lumber relative to the prices of competing materials would be necessary to make shipments of common



grades of lumber from Alaska economically feasible, due to high freight costs. Furthermore, predominant Alaskan species are especially adaptable to pulping, and Alaskan timber is more likely to be used for producing pulp than lumber.

It would appear, therefore, that most of our future imports will be from Canada, largely from British Columbia. Since timber stands in that province can be cut less expensively than in the more northern provinces, and because of the nearness of this timber to the United States, it appears that increasing volumes of British Columbian lumber will continue to flow into this country in future years.

Lumber demand would increase substantially if price relationships to competing materials stayed as they are. The price of lumber is expected to continue to rise more rapidly than the prices of competing materials, however, since only limited increases in domestic production and imports are in prospect without prohibitive increases in cost. This increase in lumber prices relative to prices of competing materials is expected to be smaller during 1952–75 than it was in 1929–52, because technological advances and pressure of competing materials will restrain increases in lumber prices.

Pulpwood, Pulp, Paper, and Paperboard. In pulpwood, pulp, paper, and paperboard production, supply factors indicate that the upward trend in production can be sustained during the next 20 years with costs maintaining their current relationship to competing materials.

Historically, the expansion of the pulp industry has been due to its ability to develop additional sources of low-cost pulping materials through modification of its processes. Significant expansion of output during the next 20 years is expected in all the major grades of pulp except soda and sulphite pulp.

Utilization factors that indicate expansion can occur without prices rising at a greater rate than prices of competing materials include:

1. The nature of the pulping process, which permits the economical use of small-size timber and forest residuals.
2. The development of more economical barkers and chippers which can increase the supply of sawmill residuals for pulping.
3. The development of, and expected improvement in, semi-chemical pulping processes, which appear to be particularly well suited to hardwood pulping.
4. Developments in sulphate pulping which have made it a versatile process capable of using practically all softwood and hardwood species for all pulp grades.
5. Adaptation of groundwood pulping to a wider range of species, including some hardwoods as well as southern pine and Douglas-fir.

In the west, increased utilization of sawmill and plywood mill residuals can provide relatively low-cost wood for a major expansion of sulphate pulp and whole-wood fiber production during future decades. Over a longer period, large volumes of wood left as logging slash in old-growth operations may also contribute greatly to the pulpwood supply. Large volumes of thinnings are available in areas of second-growth Douglas-fir.

In the east, major changes in wood supply must occur if the present level of pulp production is to be maintained. A pronounced shift toward hardwood pulping is now going on in anticipation of a reduction of Canadian imports (where wood costs are also rising) and in an effort to improve the regional competitive position.

In the south, the softwood pulpwood situation is not as critical as in the east. The use of sawmill residuals is just being developed. There is an estimated annual potential supply of mill residuals for the period of projection of from 2 to 3 million cords in the south. Logging slash might yield an equal amount of pulping materials if technological developments permit, but some price rise would probably be needed to make this slash economically usable. Considering the potential of southern pine growth under good timber management and the small log-size requirements of the pulp industry, it can be anticipated that the large forest holdings being developed by southern pulp companies will be a much more important source of pulpwood by 1975.

Insulating Board and Hardboard. It is expected that prices of insulating board and hardboard during the period covered by this study will tend to drop in relation to the prices of competing materials.

Increased interest in manufacturing these products is evidenced by the entry of two western hardboard plants in 1953 and the expectation that six more will begin production in 1954. The recent development of these products has been largely based on utilization of mill residuals, defective timber, and species for which other uses did not exist.

It is entirely possible the heavy swing toward building-board production will provide new capacity faster than the expected market growth. A major price drop may result. If this occurs, prices of building boards will then be very favorable in relation to those of competing materials.

Southern hardboard production must meet the competitive wood costs of the pulp industry. Under these conditions, there is little eagerness to enter the hardboard field there.

Plywood and Veneer. Supply and utilization prospects indicate the price of softwood plywood and veneer will probably rise in relation to the price of competing materials, but not as rapidly as hardwood products. It is expected the price rise will be relatively less than for lumber.

In the softwood plywood industry, the substitution of other materials for face veneer is likely to widen the log quality acceptable to the industry. Further im-

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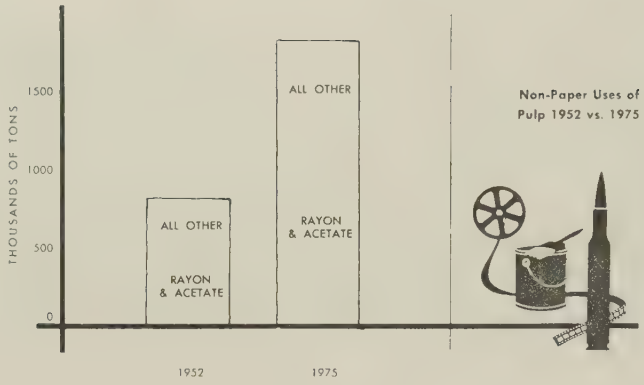


provements in patching techniques and expanded use of species other than Douglas-fir will also help to broaden the supply base.

In the hardwood plywood and hardwood face veneer industries, present costs are at such a level that imports of comparable quality can be sold for less than domestic production, and a considerable loss of markets to imports has occurred during the last two years. No great change is expected in the price of utility grades of hardwood plywood compared with competing materials, but hardwood plywood output is expected to meet more competition from softwood plywood and hardboard.

Largely as a result of using low-grade veneers in shipping containers, both softwood and hardwood container veneer, are expected to maintain present price relationships with competing materials.

To sum up this review of supply and price prospects for the major forest products, the following price shifts relative to competing materials are expected:

1. Lumber prices will probably rise more rapidly than the prices of competing materials, but the relative increase is expected to be smaller in the 1952–75 period than it was between 1929 and 1952.
2. Pulp prices are expected to hold about the same relationship to prices of competing materials as now.
3. Hardboard and insulating board prices are expected to be slightly lower in the future in relation to prices of competing materials.
4. Plywood prices are expected to increase slightly in relation to prices of competing materials, but not as much as lumber prices.

THE DEMAND FOR PULP AND PULPWOOD

The largest consumer of wood pulp is paper. In 1953, the total output of paper was about the same as paperboard, but the wood pulp requirements per ton of product were almost twice as great. As a result, about 54% of all wood pulp consumed was taken by the paper industry, as compared with about 33% by the paperboard industry. Wood pulp requirements for building papers and building boards, not included in the above figures, represented almost 9% of total wood pulp consumption, the remaining 4 to 5% being attributed to dissolving pulp uses.

Paper and Paperboard

Paper and paperboard consumption estimates in millions of tons are shown in the table below, built up from estimates of consumption of individual types of each:

Products	*1952*	*1960*	*1965*	*1970*	*1975*
Total paper	16.9	20.8	23.3	25.8	28.6
Total paperboard	12.1	16.6	19.4	22.1	24.9
Total paper and paperboard	29.0	37.4	42.7	47.9	53.5

Paper consumption, as measured by new supply (production plus imports, less exports), increased about 93% between 1929 and 1953, rising from 9.1 to 17.6 million tons. Consumption of all papers by 1975 is estimated at about 28 million tons, based on correlation with population, real disposable income, and trend; this checks reassuringly with the total estimates for each of the paper types.

Consumption of all grades of paperboard, as measured by changes in new supply, has climbed in the past quarter-century from about 4.3 million tons in 1929 to about 13.8 million tons in 1953. A continued increase is expected, but at a lesser rate. It is unlikely paperboard can find new uses as potentially large as shipping containers and packaging materials. A slower rate of growth, therefore, is reflected in an estimated future consumption of 24.9 million tons of paperboard in 1975. This estimate is based on a separate correlation of total paperboard consumption with population, real disposable income, and trend. The sum of the estimates for individual types of paperboard also provides the same estimate of total paperboard consumption by 1975.

To estimate production requirements in the United States in each of the future years, it is necessary to make allowances for net imports of paper and paperboard. In 1952, net imports totaled 4.6 million tons, with newsprint imports of 5 million tons partially offset by net exports of other grades. Heavy imports of newsprint are expected to continue; this country will remain a net importer of paper and paperboard. Net imports are estimated to reach about 6.3 million tons by 1975.

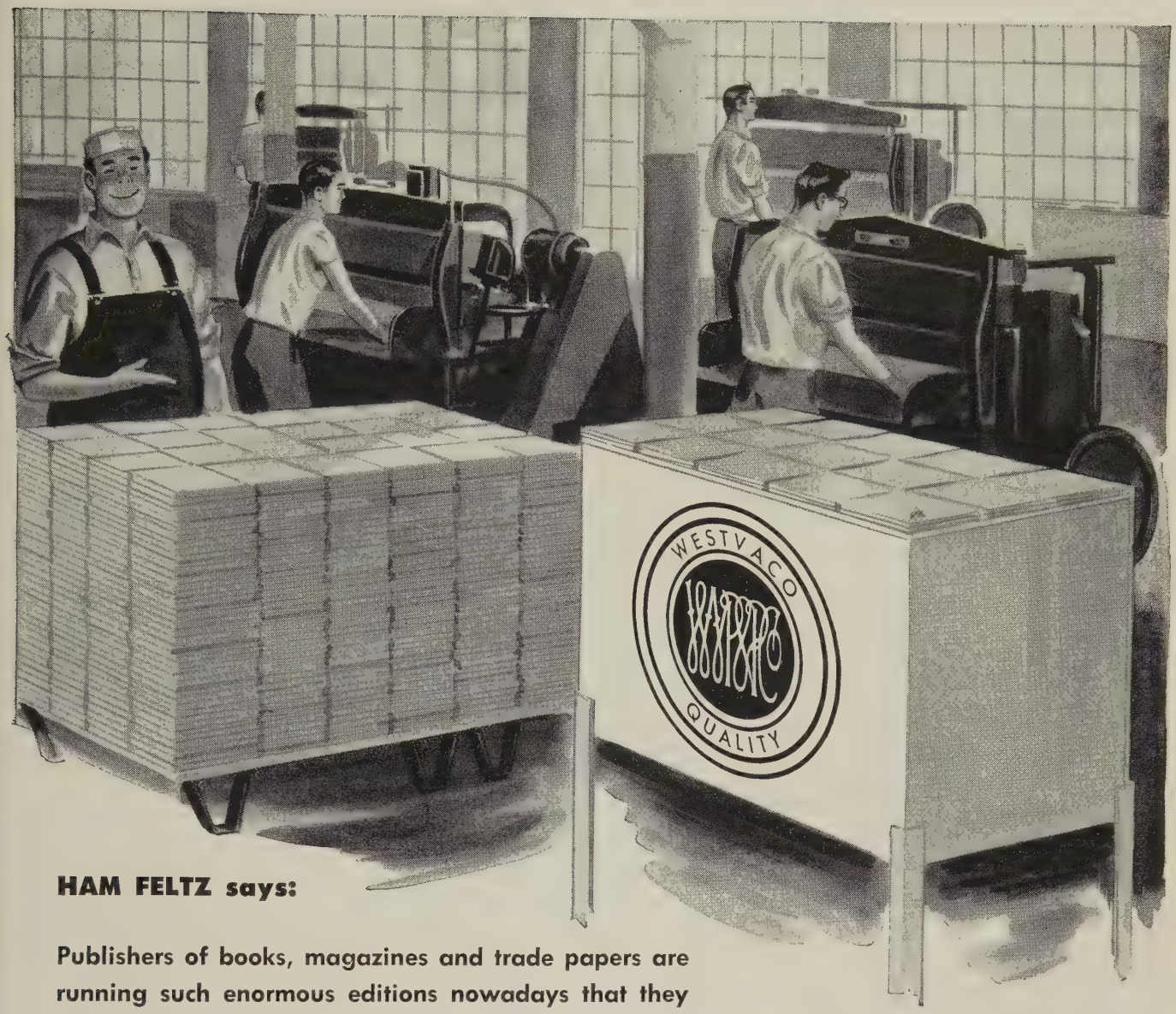
Total domestic production of paper and paperboard is expected almost to double, from 24.4 million tons in 1952 to 46.6 million tons by 1975. A summary of this production, by major paper and paperboard categories, is shown in the table.

Domestic Production of Paper and Paperboard
(Millions of tons)

Grade	*1952*	*1960*	*1965*	*1970*	*1975*
Total paper	10.9	13.6	15.4	17.1	19 0
Fine	1.3	1.6	1.8	2.0	2.3
Newsprint	1.1	1.3	1.5	1.6	1.7
Book and other printing	3.4	4.2	4.8	5.4	6.0
Coarse	3.2	3.8	4.2	4.6	5.0
Sanitary, tissue, and other	1.9	2.7	3.1	3.5	4.0
Total paperboard	10.9	14.5	16.8	19.0	21.3
Containerboard	5.8	7.4	8.5	9.6	10.7
Boxboard and other	5.1	7.1	8.3	9.4	10.6
Building paper and paperboard	2.6	3.9	4.7	5.5	6.3
Building paper	1.3	1.8	2.1	2.4	2.7
Building board	1.3	2.1	2.6	3.1	3.6
Total (all grades)	24.4	32.0	36.9	41.6	46.6

Pulp Uses Other than Paper and Paperboard

Of the 800,000 tons of wood pulp used in products other than paper and paperboard in 1952, the most important consuming industry was rayon and acetate, which took 61%. The remaining 39% was used for cellophane, lacquers, photographic film, plastics, and explosives.



HAM FELTZ says:

Publishers of books, magazines and trade papers are running such enormous editions nowadays that they use incredible amounts of paper—coated, calendered and machine finished.

Naturally they look to manufacturers like West Virginia Pulp and Paper Company as dependable sources of supply.

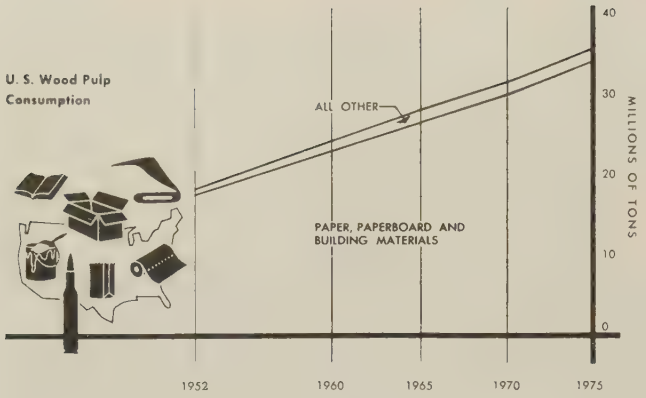
West Virginia, in turn, looks to dependable sources for felts that can stand up under long runs and high speeds at their paper machines and still give perfect finish to their sheets.

West Virginia is a mighty good customer for . . .

Hamilton Felts

MIAMI WOOLEN MILLS *Established 1858*

SHULER & BENNINGHOFEN, HAMILTON, OHIO



Most important growth area in the rayon and acetate industry has been in high-tenacity filament yarn. This growth has been due primarily to the tire cord and fabric market. From less than 1% of this market in 1937, high-tenacity rayon soared to 64% by 1950 and to about 77% by 1952.

Textile consumption of rayon and acetate declined in the latter part of 1953, reflecting not only growing competition from other man-made fibers, but also from cotton, which is gaining an increasing share of the apparel market as a result of new finishes and dyes. It is expected by 1975 rayon and acetate will be about 23% of mill consumption of fibers, compared with 18.9% in 1952. This indicates a declining rate of growth for rayon and acetate in the textile industry.

Wood pulp consumption in other products has climbed from about 70,000 tons in 1939 to about 308,000 tons in 1952. It is estimated total pulp consumption in these other uses will reach about 600,000 tons by 1975.

Total nonpaper uses of wood pulp are expected to rise from 800,000 tons in 1952 to about 1,800,000 by 1975.

Wood Pulp Requirements

Wood pulp needed to produce the paper and paperboard shown in the preceding tabulation, together with quantities required for the production of other products, was estimated on both statistical and qualitative bases. All estimates provided similar answers, although the qualitative estimates, based on a detailed evaluation of each of the producing industries, were used for this study.

The qualitative estimate, based on the probable composition of the furnish per ton of each of the major classes of paper and paperboard for each of the target years, shows that by 1975, 36.1 million tons of wood pulp will be consumed in all products, with 34.3 million tons required for the production of paper and paperboard alone. A detailed breakdown of wood pulp consumption by type of pulp and by use is shown in the table.

Estimated Consumption of Wood Pulp in the United States

(Millions of tons)

Product and type of pulp	*1952*	*1960*	*1965*	*1970*	*1975*
For paper, paperboard, and building materials—total	17.3	23.1	26.8	30.3	34.3
Unbleached sulphate	6.3	7.4	8.2	9.1	10.0
White pulps[a]	6.3	8.7	9.2	9.9	10.7
Groundwood	2.6	3.5	4.1	4.6	5.1
Defibrated or exploded	1.1	1.7	2.5	2.6	3.1
Semichemical	0.8	1.6	2.6	3.9	5.2
Screenings, damaged, etc.	0.2	0.2	0.2	0.2	0.2
For all other products[b]	0.8	1.2	1.4	1.5	1.8
Total pulp	18.1	24.3	28.2	31.8	36.1

[a] White pulps include bleached and unbleached sulphite, bleached and semibleached sulphate, and soda pulps.
[b] Primarily alpha and dissolving pulps.

Estimates of wood pulp consumption are determined by multiplying the estimated production of paper and paperboard in the United States in each of the future years by the quantity of wood pulp expected to be required per ton of product, based on estimates of the furnish to be used.

Average furnish composition is not compiled regularly by any trade association or public agency concerned with pulp and paper. Furthermore, considerable variation is known to exist in the furnish used by different companies. Estimates of the average furnish by product were made for 1952 and extended to future years, based on a study of industry practice regarding furnish and yields by type of pulping process.

Estimates of the wood pulp required to produce a ton of paper and paperboard in future years are affected by the furnish used for each grade of paper and paperboard, and also by the product mix. Net effect of these factors indicates an industry-wide average of 0.73 ton of wood pulp per ton of paper and paperboard for 1975, compared with 0.708 ton in 1952. The quantity of wood pulp per ton of paper and paperboard in the target years is in the following table.

Estimated Wood Pulp Consumption per Ton of Paper and Paperboard Produced

	Type of product, tons				
	1952	*1960*	*1965*	*1970*	*1975*
Paper					
Fine	0.85	0.85	0.85	0.85	0.85
Newsprint	1.05	1.05	1.05	1.05	1.05
Book and other printing	0.80	0.81	0.83	0.84	0.85
Coarse	0.99	0.99	0.99	1.00	1.00
Sanitary, tissue, and other	0.97	0.97	0.98	0.99	0.99
Paperboard					
Containerboard	0.67	0.68	0.69	0.71	0.72
Boxboard and other	0.35	0.37	0.38	0.39	0.40
Building materials					
Building paper	0.35	0.37	0.39	0.42	0.45
Building board	0.90	0.91	0.93	0.94	0.95

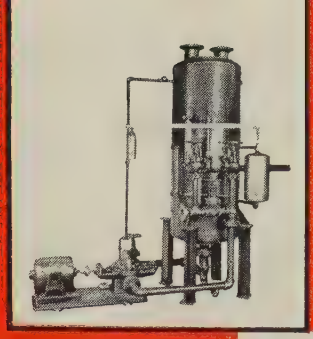
Estimates of the type of pulp that will be produced to meet the requirements for paper and paperboard demand were made for each of the products shown in the above table. Probably the most important change anticipated is the increased use of semichemical pulps in the furnish of both paper and paperboard. There is every indication that semichemical pulping will prove to be a versatile procedure suitable for producing pulp usable in a wide range of products from many species, including hardwoods.

The proportion of bleached and semibleached sulphate pulp in the white pulp classification, which includes also sulphite and soda pulps, is expected to rise steadily. Technological improvements have made the sulphate pulps extremely versatile in end uses, including most of the uses of the sulphite pulps, while maintaining and improving their flexibility in terms of wood sources. Little further expansion in capacity of sulphite and soda pulps is foreseen.

These changes are expected in the composition of the furnish of the various classes of paper and paperboard:

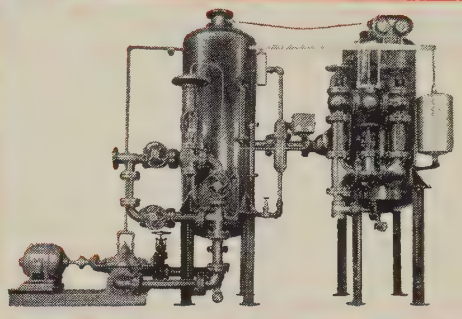
1. Fine papers: expanded use of semichemical pulps, displac-

small



For small machine

medium



For medium sized machine

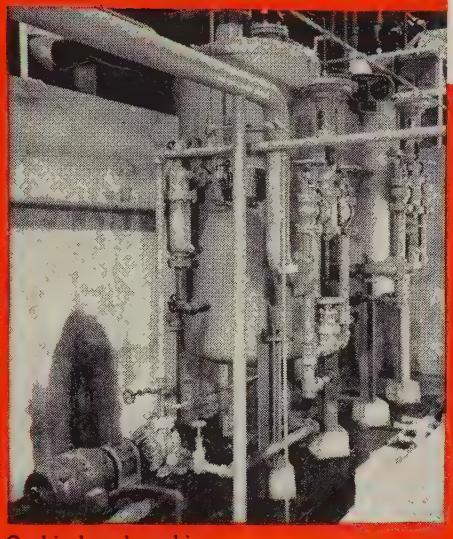
10% to 30% production increase.

Positive reduction in steam costs—even with tonnage gains.

Improved quality. Uniform drying.

Less cockle or curl.

Moisture content control. No over-drying.



On big board machine

and large

they all need fulton systems

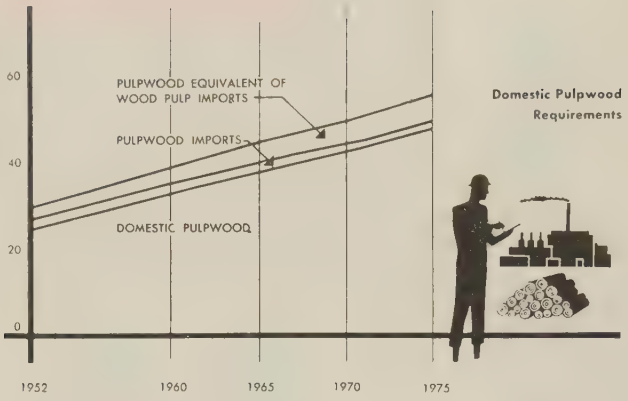
Today practically all of our large paper machines are 100% Fulton dryer drainage equipped – a great majority of the medium size machines have Fulton Systems and the smaller and older machines are fast installing Fulton Systems. As a matter of fact, Fulton Dryer Drainage is being specified by all of today's paper machine builders.

Compared to the potential increase in dryer speed and tonnage gain – the quality step-up – the steam economy – the modest initial cost of Fulton equipment is literally insignificant. It should, therefore, surprise no one that Midwest is able to tally the installation of 1000 Fulton Systems – in new mills, old mills, large mills, small mills.

Get technical bulletin . . . Check with user mills . . . Have us survey and estimate cost.

ROSS MIDWEST FULTON CORP. • DAYTON, OHIO

Both paper machines and pulp dryer at the new Bowater mill are equipped with our systems.



ing some white pulp, notably bleached sulphite and soda pulps.

2. Newsprint: development of the use of semichemical pulps, substituting in part for the white pulps (unbleached sulphite) and in part for the groundwood.
3. Book and printing papers: increasing use of both semichemical and groundwood pulps, with both replacing some of the white pulp.
4. Coarse papers: limited use of semichemical pulp.
5. Sanitary, tissue, and other papers: little change.
6. Paperboard: expansion of semichemical pulp use, replacing wastepaper, straw, and other nonwood materials, but with a limited displacement of sulphate.

Pulpwood Requirements

The following tabulation shows the steps involved for computation of domestic pulpwood requirements for 1952 and each of the target years:

(Millions of cords, roughwood basis)

	1952	*1960*	*1965*	*1970*	*1975*
Pulpwood equivalent of wood pulp consumed	29.5	38.9	44.1	48.9	54.8
Pulpwood equivalent of imports of wood pulp	3.0	4.1	4.7	5.3	6.0
Pulpwood consumed in U. S.	26.5	34.8	39.4	43.6	48.8
Net imports of pulpwood	2.0	1.4	1.3	1.3	1.3
Requirements for domestic pulpwood	24.5	33.4	38.1	42.3	47.5

Domestic Pulpwood Sources by Region

Table IV shows the estimated sources of domestic pulpwood requirements, broken down by regions, by hardwoods and softwoods, and between logs and bolts‡ and mill residuals.

The changes from 1952 to 1975 shown in Table IV in millions of cords, roughwood basis, can be summarized as follows:

‡ A bolt is a short log.

(Millions of cords, roughwood basis)

Type of wood	*East*	*South*	*West*	*Total U. S.*
Increase in softwood logs and bolts	−0.4[a]	6.8	1.1	7.5
Increase in hardwood logs and bolts	2.3	5.3	...	7.6
Increase in mill residuals	0.9	3.4	3.6	7.9
Total increase in pulpwood supply	2.8	15.5	4.7	23.0

[a] Decrease.

Although softwood logs and bolts accounted for 80% of domestic pulpwood production in 1952, they account for only about a third of the expected increase in total pulpwood production between 1952 and 1975. Most of the increase in softwood logs and bolts is expected in the south, reflecting the large forest holdings being developed by the pulp companies and the fast growth of pulping species.

The expected increased production of hardwood logs and bolts in the east and south reflects development of new pulping processes to utilize hardwoods, the relative abundance of hardwood supplies in these regions, the importance of utilizing the whole forest crop in managed forests, and the expected reduction of imports of Canadian pulpwood in the east.

The sixfold increase in the use of mill residuals, from 1.5 million equivalent cords in 1952 to 9.4 million in 1975, is based on the potential supply of chippable material, and the probable economic feasibility of using it, in each region.

The potential annual supply of chippable material in the east between now and 1975 is estimated at about the equivalent of 2 million cords based on annual lumber production of 3.1 billion board feet of hardwoods and 2 billion board feet of softwoods under present industry organization.

	Yield of chippable material (thousands of equivalent standard cords, roughwood basis) *Softwoods*	*Hardwoods*
From eastern sawmills with annual production of:		
More than 10 million board feet	50	70
5 to 9.9	50	70
1 to 4.9	270	400
Less than 1	500	700
Total	870	1240

The potential volume of chips from mills of sufficient size to utilize expensive barker and chipper installations economically is very limited. Also, about 60% of the present pulp capacity in the east is in sulphite and

Table IV. Domestic Pulpwood Production by Region and Type of Wood, 1952–75
(Millions of cords, roughwood basis)

Region	*1952* Total	Softwood	Hardwood	*1960* Total	Softwood	Hardwood	*1965* Total	Softwood	Hardwood	*1970* Total	Softwood	Hardwood	*1975* Total	Softwood	Hardwood
Total U. S.	24.5	21.0	3.5	33.4	27.1	6.3	38.1	29.9	8.2	42.3	32.3	10.0	47.5	35.0	12.5
Mill residuals	1.5	1.4	0.1	3.3	3.1	0.2	5.6	5.0	0.6	7.4	6.3	1.1	9.4	7.9	1.5
Logs and bolts	23.0	19.6	3.4	30.1	24.0	6.1	32.5	24.9	7.6	34.9	26.0	8.9	38.1	27.1	11.0
East	5.7	4.0	1.7	6.3	4.0	2.3	7.0	4.0	3.0	7.6	4.0	3.6	8.5	4.0	4.5
Mill residuals	0.02	..	0.02	0.1	0.05	0.05	0.2	0.1	0.1	0.5	0.2	0.3	0.9	0.4	0.5
Logs and bolts	5.7	4.0	1.7	6.2	3.95	2.25	6.8	3.9	2.9	7.1	3.8	3.3	7.6	3.6	4.0
South	14.5	12.7	1.8	21.1	17.1	4.0	24.1	18.9	5.2	26.8	20.4	6.4	30.0	22.0	8.0
Mill residuals	0.1	0.02	0.08	0.7	0.5	0.2	2.0	1.5	0.5	2.8	2.0	0.8	3.5	2.5	1.0
Logs and bolts	14.4	12.7	1.7	20.4	16.6	3.8	22.1	17.4	4.7	24.0	18.4	5.6	26.5	19.5	7.0
West	4.3	4.3	..	6.0	6.0	..	7.0	7.0	..	7.9	7.9	..	9.0	9.0	..
Mill residuals	1.4	1.4	..	2.5	2.5	..	3.4	3.4	..	4.1	4.1	..	5.0	5.0	..
Logs and bolts	2.9	2.9	..	3.5	3.5	..	3.6	3.6	..	3.8	3.8	..	4.0	4.0	..

Source: Stanford Research Institute.

Quick Check List

OF INSTRUMENTS BY FOXBORO

Reg. U. S. Pat. Off.

INDICATORS • RECORDERS • CONTROLLERS

***Conductivity**

***Consistency**

Density (Specific Gravity)
differential pressure type

Flow
mercury-manometer type
"d/p Cell", force-balance transmitter type
float-and-cable type

Humidity
wet-and-dry-bulb temperature
relative humidity (hygroscopic type)
absolute humidity and dew point temperature ("Dewcel")

Liquid Level or Interface (in open or pressured vessels)
diaphragm type
bubble tube (purge) type
differential pressure type

***Load, Force, and Torque**

***Moisture Content (sheeted materials)**

Motion and Position Recorders

***Motor Load (Power)**

Operation Time Recorders

***Oxidation—Reduction Potential**

***pH (with Beckman glass electrodes)**

Pressure, Absolute Pressure, and Vacuum
spring and hydron types
differential type
*electric pressure cell types

***Resistance (Electric)**

***Speed (R.P.M. or Lineal)**

Temperature
filled-system types
resistance bulb ("Dynalog" electronic and galvanometer types)
thermocouple ("Dynalog" electronic and galvanometer types)

***Tension**

***Thickness (sheeted materials)**

***Viscosity**

***Voltage, Current, Impedance, Dielectric**

***Weight (sheeted materials in process)**

***Weight and Force (strain gauge type)**

**with Dynalog Electronic Instruments*

CONTROLLER TYPES

Pneumatic

Model 40: On-Off
Proportional
Proportional with Derivative
Proportional with Reset ("Stabilog")
Proportional with Reset and Derivative ("Hyper-Reset")
Consotrol (Console/Graphic Panel Types): in all above control mechanisms except on-off

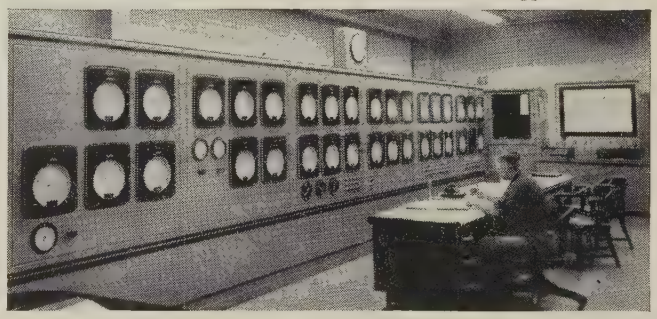
Model 41: On-Off and Proportional
Circular Case: On-Off and Proportional

Electric

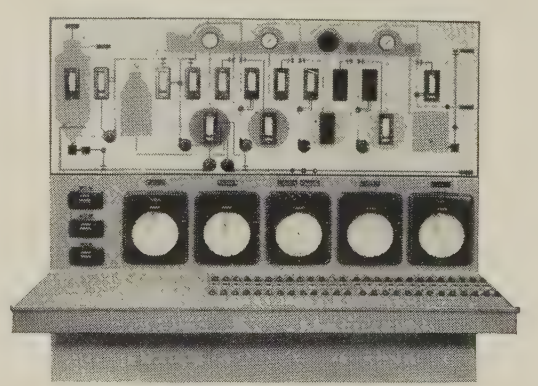
Rotax (rotary contact type)
On-Off
Multi-Position
Galvanometer Type
On-Off
2- and 3-position
Proportioning

CONTROL SYSTEMS

Auto-Selector	Ratio
Averaging	Relation
Dual	Sequence
Duplex	Time Schedule (cam and camless types)
Limit	

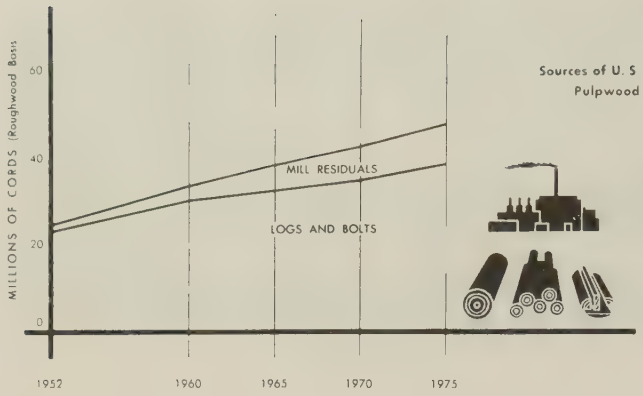


Complete Washer and Bleach Control Panel by Foxboro at S. D. Warren Company, Cumberland Mills, Maine.



Foxboro Graphic Panel for centralized control of brown stock washing at Gaylord Container Corp., Bogalusa, La.

THE FOXBORO COMPANY, 781 Neponset Ave., Foxboro, Mass., U.S.A.



groundwood pulps. These are processes for which mill residuals show little promise. At least in the immediate future, chip utilization appears limited in this region.

However, as economical methods of collecting and chipping residuals from small and scattered mills are developed in other areas, it is probable that these methods will be adapted to eastern conditions. Thus a more rapid expansion of pulp use of residuals is expected in the 1960's, while by 1975 it is estimated that about 11% of domestic pulpwood production in the east will be in the form of chips.

The following table of potential supply of chippable material in the south during the early 1960's is based on expected annual production of 9 billion board feet of softwood lumber and 5 billion board feet of hardwood lumber, distributed among mills by size essentially as at present:

	Yield of chippable material (thousands of equivalent standard cords, roughwood basis)	
	Softwoods	*Hardwoods*
From southern sawmills with annual production of:		
More than 10 million board feet	520	250
5 to 9.9	490	250
3 to 4.9	380	200
1 to 2.9	1040	540
Less than 1	1660	810
Total	4090	2050

Because a large number of small mills in the south produce lumber from small logs, chip utilization has been insignificant. The possible availability of whole-log barkers that will be economically feasible for mills with capacities as low as 20,000 board feet per day (about 5 million per year) may make possible the utilization of a larger quantity of chippable material. Efforts are also being made to concentrate slabs with bark at pulpwood shipping points in the south for mass transportation to pulp mills. Although the small size of slabs has made the development of economical slab barkers difficult, such debarking appears feasible under some conditions. Separation of bark from the chips may also prove technically feasible, despite early disappointments with flotation systems.

The estimate of 700,000 equivalent cords of mill residual utilization by 1960 is based on the expectation that the majority of mills cutting more than 10 million board feet annually will be selling chips. A small quantity of chippable materials is expected to come from smaller mills. It is believed that, as experience is gained in collecting wood from slab concentration areas and as new techniques are developed, a continued rapid expansion of mill residual utilization will be possible during the 1960's.

The estimate of 3.5 million cords from mill residuals by 1975 represents more than half the potential supply in that year. In view of the scattered small mills that characterize the southern lumber industry, this is believed to be about the maximum utilization economically feasible.

The potential supply of chippable materials in the west, with a lumber production of 20 billion board feet annually and with about the same proportions of large and small mills as now, is estimated at about 8.8 million cords. This potential supply is also based on the assumption that either whole-log or slab barkers will be used for handling all the material. Nearly a third of this material is produced in mills cutting less than 10 million board feet of lumber annually.

On a regional basis, this chippable material potential is located as follows:

1. In the Douglas-fir region of western Washington and Oregon, with an assumed annual lumber output of 10 billion board feet, 4.33 million cords are assumed to be available, plus an additional 0.33 million cords of pulp chips from the production of 3 billion square feet ($^3/_8$ in. equivalent) of plywood. About 40% of this material is produced in southwest Oregon, where there is little present pulp production capacity.
2. In the California pine and redwood regions, with an assumed annual lumber output of 5 billion board feet, 2.15 million cords of chippable material suitable for pulping may be expected.
3. In the remainder of the west, including eastern Washington, eastern Oregon, and the Rocky Mountain area, with an assumed lumber output of 5 billion board feet annually, 2 million cords of chippable materials are estimated.

At present, most of the more economical sources of chips have been brought into use, although some further increases from existing sources can be obtained through additional barker installations. The most important source of additional chip use in the west probably will be additional pulp capacity in other lumber-producing areas within the region.

It is probable that any substantial increase in residual utilization in the west over the 5 million cords estimated for 1975 could be attained only at rapidly rising costs. Furthermore, the achievement of this level depends on the location of new pulping capacity in the lumber-producing areas not now serving pulp mills.

THE DEMAND FOR PLYWOOD, VENEER, AND BUILDING BOARDS

Demand for veneers and plywood is chiefly from the construction and shipping-containers industries, with the remainder going into a wide variety of manufactured products. About two thirds of the veneer is used to manufacture plywood, of which about 50% is used in residential and nonresidential construction of all types.

Demand for Building Boards (Insulating Board and Hardboard)

Because building boards compete with plywood, their demand is discussed here, even though material requirements for building boards are included under paperboard.

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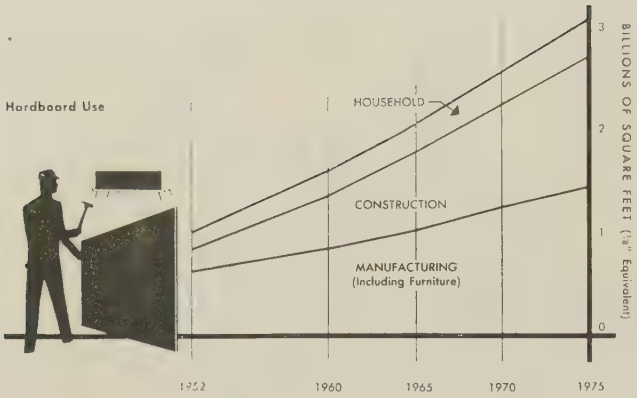

Consumption of building board, as indicated by changes in new supply, has grown more than tenfold since 1929, with the bulk of the increase coming since the beginning of World War II. The greatest relative increase has been in hardboard; about 16 times as much hardboard was used in 1953 as in 1929. Insulating board has also shown a healthy 700% increase during the same period.

Insulating Board Demand. Insulating board, which is known also as structural or rigid insulation, is produced from wood fiber and sugarcane bagasse. It is used as a facing material for interior walls and ceilings—in a variety of forms including planks, tileboard, and sheets. It is also used on exterior walls as a sheathing material, or in some cases as an exterior facing material.

As an exterior wall sheathing material, insulating board accounted for about a quarter of the residential exterior wall sheathing market in 1953. In 1920, it accounted for only about 4% of this market. It is expected, because of the cost advantages of insulating board, that its share will rise to about 34% by 1975, largely at the expense of lumber.

Insulating boards as a facing material for interior walls and ceilings are used in new residential construction, for maintenance and repair of residential construction, and in nonresidential building. In new residential construction, as reported by residential contractors in 1953, insulating board was used on about 2% of the interior wall and ceiling areas. This represents a decline from an estimated 7% of the ceiling facing market in 1929 and 3% of the interior wall facing market in the same year. For the additions and alterations market, however, it is easily handled by the amateur and provides a low-cost facing material for such uses as the conversion of attic space to usable living area.

Hardboard Demand. Hardboard differs from insulating board by its greater density and rigidity, harder surface, and greater resistance to impact. The following tabulation shows hardboard use in 1952, with projections to 1975.

(Millions of square feet—1/8 in. equivalent)

Year	*Construction*	*Furniture*	*Manufacturing*	*Household*	*Total*
1952	220	325	280	175	1000
1960	530	430	400	240	1600
1965	770	530	460	270	2030
1970	1000	650	570	330	2550
1975	1280	780	630	360	3050

Source: Actual—U. S. Dept. of Commerce and Stanford Research Institute.
Estimates—Stanford Research Institute.

Hardboard is used by the furniture and fixtures industry to an increasing extent in drawers, dresser backs, under plastic surfaces in dinette sets, and for table tops in inexpensive furniture built for hard wear. In the fixtures segment of the industry, it is used for displays, counters, and partitions.

Hardboard is being used more by the construction industry—both residential and nonresidential—because of its relatively low cost and adaptability to many uses. Estimates of the consumption of hardboard in new residential construction are shown in the following table.

Consumption of Hardboard in New Residential Construction

Year	*Floors*	*Ceilings*	*Roofs*	*Interior walls*	*Millwork, accessory buildings, and miscellaneous*	*Millions of square feet*	*1/8 in. equivalent*
1950	25	...	...	...	3	28	34
1953	15	23	17	41	14	110	126
1960	45	50	40	95	30	260	300
1965	60	85	65	155	55	420	475
1970	60	115	95	230	70	570	645
1975	70	145	130	320	95	760	860

As an underlayment material in new residential construction, hardboard accounted for about 2% of the market in 1953. It is expected that by 1975 hardboard will have about 8% of this market, in the face of stiff competition from plywood.

From about 1% of the interior wall surfacing market in 1953, hardboard is expected to reach 5% by 1975; in the ceiling surfacing use, hardboard is expected to increase from the present 2% to 8% of the market. Gains are also expected in the use of hardboard as roof sheathing and for doors, cabinets, and trim.

Hardboard in nonresidential construction is largely used for concrete forms and interior partitions forming permanent parts of a building. On the farm, hardboard is adapted to many uses, such as exterior wall covering, partitions, and bins. With hardboard expected to gain relative price advantages and to enjoy continued product improvement, it is probable that the use of hardboard per dollar of nonresidential construction will continued to increase, and that by 1975 about 350 million square feet of hardboard might be consumed in nonresidential construction, as compared with slightly more than 100 million in 1952.

In the manufactured products also, hardboard has become increasingly popular in motor vehicle bodies, signs, toys and play equipment, electrical panels, aircraft die stock, and many other products. It is likely hardboard usage will continue to increase more rapidly than the growth of these using industries themselves. Based on these factors and the estimated increase in industrial production discussed above, it is estimated that hardboard consumption in manufactured products might reach 630 million sq. ft. by 1975.

In the home-use market, hardboard is suitable for interior walls and ceilings, closet doors, furniture, work surfaces, portable partitioning, shelving, and many other uses. It can readily be installed by amateurs, and it wears well. From about 175 million sq. ft. in 1952, home consumption of hardboard will probably increase to about 360 million sq. ft. by 1975.

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Total hardboard consumption in all uses is expected to go from the 1952 level of about 1 to about 3 billion sq. ft. by 1975.

THE DEMAND FOR OTHER FOREST PRODUCTS

In addition to lumber, plywood, and pulp products, a number of other forest products account for the balance of timber use. Chief among these are fuelwood, shingles and shakes, cooperage, piling, poles, wood for distillation and charcoal, and a large number of miscellaneous uses. Fuelwood is the most important in terms of wood requirements.

Metal-working industries, especially those supplying copper and brass, tinsmiths and silversmiths, and many fabricating plants requiring conveniently handled high-temperature heat without smoke or fumes, are regular charcoal users. About 20% of charcoal production is used in the preparation of carbon bisulphide, an essential solvent in the manufacture of viscose-type rayon, and as a filtering medium and decolorizing agent in many chemical processes.

The largest market for charcoal is for domestic use, where about half the charcoal output is consumed. This market is expected to increase with the trend to outdoor living.

Consumption of distillation wood is expected to increase from about 500,000 cords in 1952 to about 600,000 cords by 1975, primarily as a result of increased charcoal demand.

Miscellaneous Forest Products

In addition to the major uses of forest products outlined in previous sections, an indeterminate amount of wood is used in various other products.

Use of wood for the production of chemicals, other than wood used in distillation, is of minor importance as a demand for timber, since it utilizes almost entirely forest and mill residuals and pulping liquors. Turpentine, for example, is essentially a forest industry by-product, utilizing stumps, top wood, and waste sulphate pulping liquors. Tall oil, another wood chemical, is a by-product of the kraft pulping industry and is used in the manufacture of soaps and detergents, surface coatings, linoleum, chemicals, and other products. Although 400 million pounds were produced from waste pulp liquors in 1951, it is highly unlikely that tall oil will ever be produced as a primary product in competition with fatty acids from other sources.

SUMMARY OF MAJOR CONCLUSIONS§

The major conclusions of this study, as presented in the previous sections of this report, can be summarized as follows:

1. Substantial population increases, technological advances, and increases in living standards will expand the size and activity of the United States economy by 1975.

2. This general economic expansion will result in corresponding increases in activity in construction (especially residential), shipping containers, and manufacturing—the major markets for forest products.

3. Despite these expanded markets, substantial increases in the supply of lumber, either from domestic production or from imports, are likely to be forthcoming only at costs that will encourage the substitution of competing materials for lumber. The price of lumber relative to competing materials will increase, although less rapidly than in the past, and lumber will lose part of its markets.

4. The price of plywood will increase (but less rapidly than that of lumber) relative to competing materials; the prices of pulp and paper products will continue in about their present relationship to prices of competing materials; the prices of hardboard and insulting board will decline relative to those of the materials with which they compete.

5. Domestic production of lumber will increase only moderately by 1975, with all the increase in softwood lumber production occurring in the west, accompanied by more moderate increases in hardwood lumber production in the south and east.

6. Despite higher lumber prices, there should be a market for all the lumber produced in the United States, plus a moderately higher level of imports (primarily from Canada) and increased re-use of salvaged lumber.

7. Major increases are expected in the domestic production and consumption of pulp, paper, and paperboard products, plywood and veneer, and hardboard and insulating board.

8. A major decline is probable in fuelwood consumption. By 1975, this product will be used primarily in fireplaces, with a virtual disappearance of its uses in residential heating and cooking.

9. Only moderate changes from their 1952 levels are foreseen for the domestic consumption and production of other forest products by 1975.

10. Total domestic requirements for sawtimber delivered to mill sites are expected to increase by only about 3.4% between 1952 and 1975. This modest increase reflects the relatively mild increase in probable lumber production, more extensive use of small logs below present minimum sawlog standards, and a substantial reduction in the use of sawtimber for fuelwood.

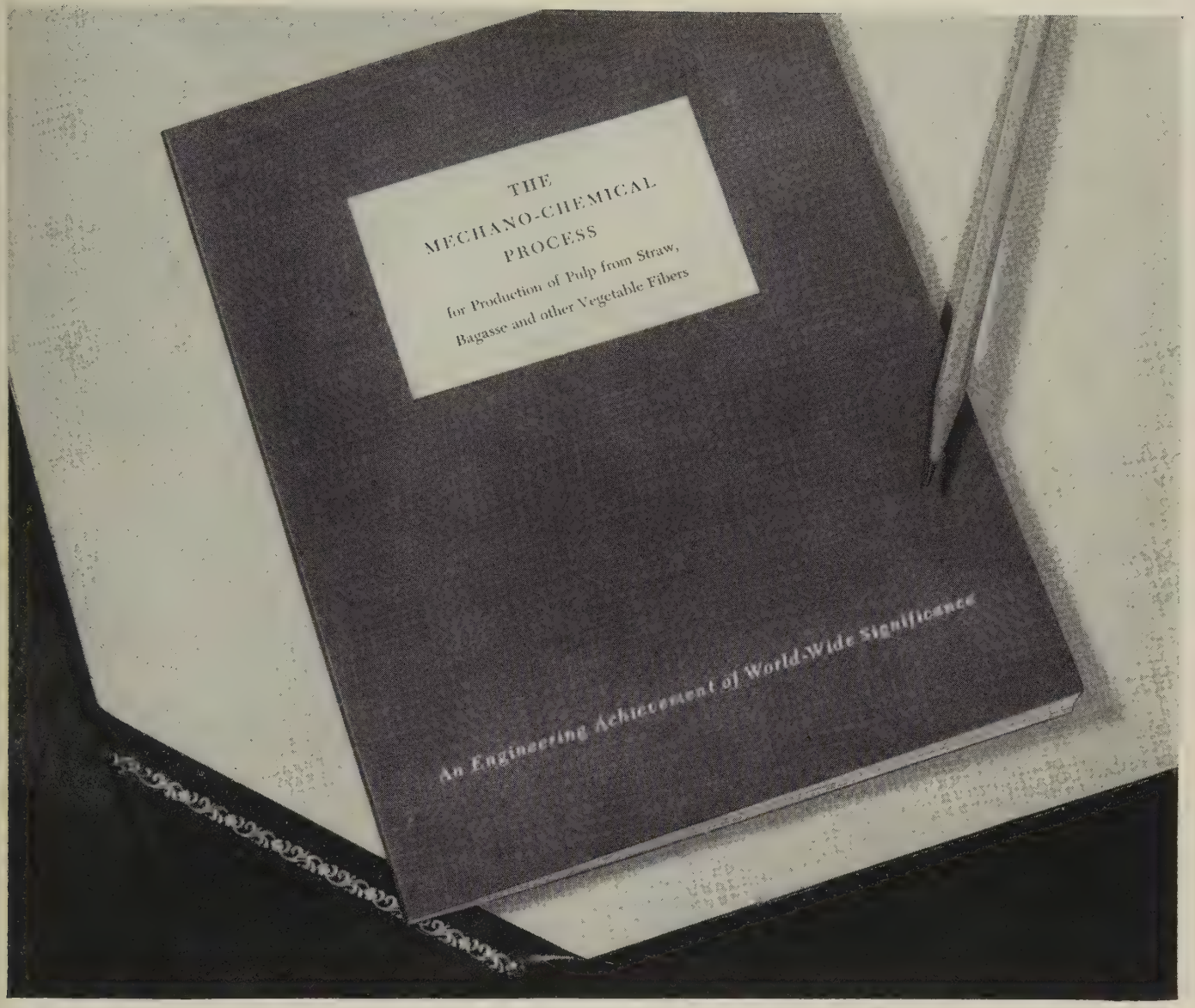
11. Total domestic requirements for all timber delivered to mill sites, in cubic feet, will increase by about 14% between 1952 and 1975. This relatively greater increase in cubic volume, as compared to board feet of sawtimber, reflects partly the expected increased relative importance of pulp in total timber use and partly the probable general shift in all regions toward the use of smaller logs.

12. Increases in the use of mill residuals to produce pulp and other fiber products will be substantial in the west and south, but less pronounced in the east. This increased use of mill residuals will meet about a third of the increase in domestic pulpwood requirements.

13. Improved pulping methods will result in greater use of hardwoods, particularly in the south and east.

14. The major increases in timber use in the south will be for pulp and for hardwood lumber production; in the west, for softwood lumber and plywood production, with mill residuals providing material for increased pulp and hardboard production. The east will show moderate increases for lumber and pulp uses of timber, but a decline in total timber use.

§ The conclusions of the published summary are included herein, and, in the event that there is interest in a section deleted from this presentation, reference should be made to the original text.



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Many worth-while new ideas and laboratory discoveries have lingered in the minds and notebooks of men without an avenue through which to evaluate them and gain sufficient understanding to make them useful. The great gap between small-scale laboratory bench research results and actual production must be spanned and confidence of manufacturing personnel gained before practical use can be made of research results. It is often too costly to interrupt mill operations to make large-scale experiments and risk complete loss of production.

Years may be spent in theoretical pursuit of a solution to a problem on a test tube scale, yet when an answer is found it must be evaluated on a pilot scale to orient with manufacturing. This means that an experimental pulp and paper mill is required. In terms of time, the need of a single company for an experimental mill may be only for a few days or weeks per year. Thus it is not expedient for most companies to maintain and staff this facility to be idle much of the time. It is much less costly and objective results can be readily obtained in an independent laboratory. There, new or modified processes can be economically tried out and the major operational difficulties eliminated before making test runs in the mills. New products can be manufactured, evaluated, and submitted for market tests without jeopardizing one hour of regular mill production.

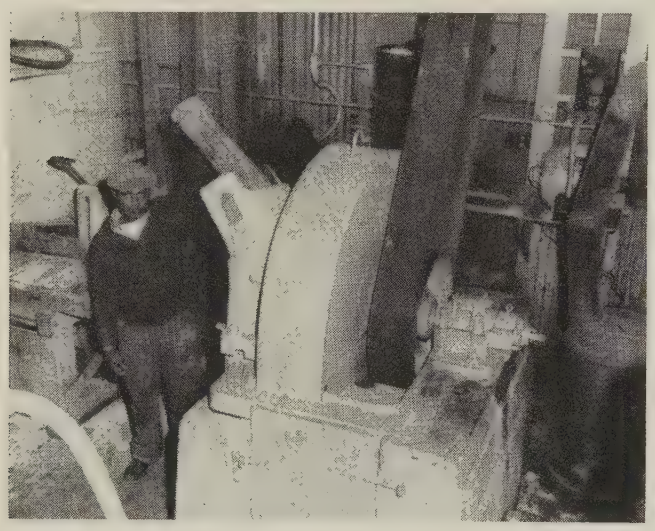

Fig. 1. Carthage chipper

At the Herty Laboratory, equipment is available for chip preparation, screening, pulping, bleaching, refining, papermaking, calendering, and coating. Component machines may be used separately or in groups as production units when desired.

Chemical, semichemical, acid, alkaline, neutral, or mechanical pulps may be prepared. A four-knife Carthage chipper (Fig. 1) is used when chips are required. These are screened to a desired size on a mechanical screen shown in Fig. 2. For pulping, a rotary and a stainless digester of 400 to 600 lb. chip capacity (Figs. 3 and 4) are used; for groundwood, the three-pocket Carthage grinder (Fig. 5) is employed.

Reavis C. Sproull, Director. Herty Foundation Laboratory, Savannah Ga.

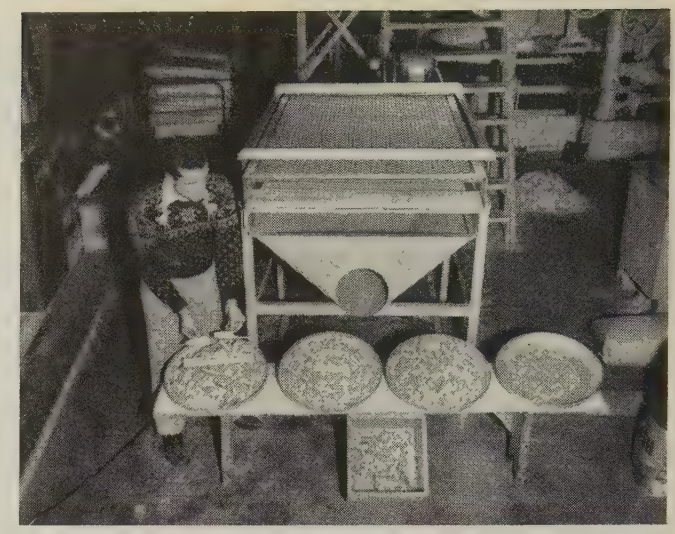

Fig. 2. Chip screen

For preliminary refining or opening the chips, the Reitz disintegrator (Fig. 6) or Sprout-Waldron 36-2 refiner with peripheral control ring (Fig. 7) are most valuable. Each of these refiners may also be adjusted to produce special hydration effects. For bleaching the rubber-lined Hooker chlorinator (Fig. 8) is used in conjunction with tile-lined Hollander beaters of 75 and 300-lb. pulp capacity (Fig. 9). By a combination of these, multi-stage effects can be obtained.

Special attention has been given to refining equipment. In addition to refining machines already mentioned, two Hermann Manufacturing Co. claflins, a Jones pony jordan (Fig. 10), a Noble & Wood Unifiner (Fig. 11), and a Noble & Wood Microfiner (Fig. 12) are available. These refiners and beaters used in combinations will produce almost any hydration and beating effects for manufacture of many varieties of paper and paper products.

Perhaps the most vital single unit is the experimental fourdrinier machine (Fig. 15) which makes paper by the same principle and of equal quality as the large commercial machines, yet its small size permits use of a few hundred pounds of pulp to make a close study of performance. Ahead of the machine proper is a Bird Co. Dirtec (Fig. 13) and a six-plate flat screen. These are used to remove foreign particles and oversize clumps, shives, or knots and are of special value on white papers and bleached pulps. The machine is 31 in. wide, carries a 33-ft. wire, and operates at a speed from 8 to 160 f.p.m. It has five driers and a seven-roll calender stack and

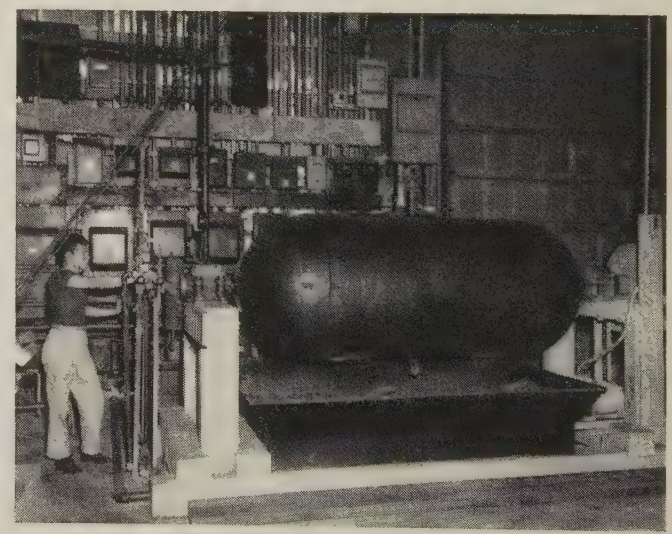

Fig. 3. Common iron rotary digester

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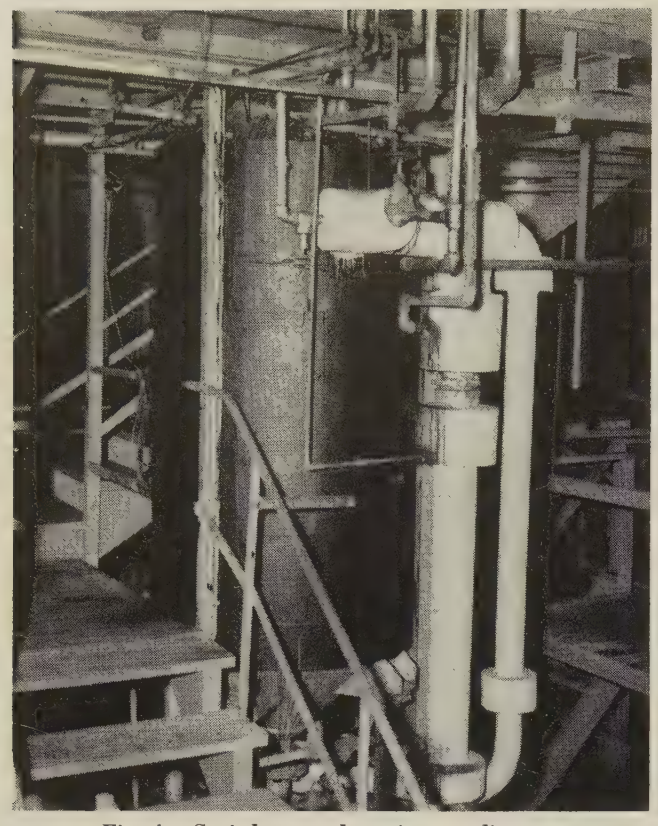

Fig. 4. Stainless steel stationary digester

slitter attachment. When required for a particular experiment, special modifications are made in the machine and extra attachments used.

For finishing and densifying the sheet, a Waldron supercalender (Fig. 14) 36 in. wide is used. When coating experiments are needed, a Waldron Microjet coater (Fig. 16) is available.

Supplementary testing and product evaluation facilities are included. Figure 17 shows the Noble & Wood pulp evaluation equipment. Figure 18 is a view of pentosan determinations in progress. Figures 19 and 20 show technicians making titrations on cooking chemicals and extractions, respectively. Figure 21 is a view in the controlled humidity

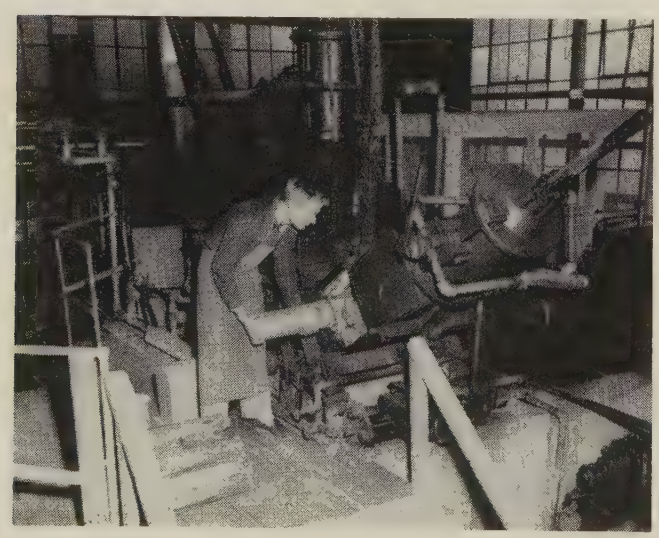

Fig. 5. Carthage three-pocket grinder

room where physical tests are made on the paper products Principal items of evaluation equipment include: Valley beater and handsheet formation equipment, Noble & Wood 9-lb. cycle beater, Noble & Wood handsheet forming and drying equipment, Schopper-Riegler and Canadian Standard freeness testers, Clark fiber classifier, Williams centrifuge, Schopper tensile tester, Thwing Albert tear tester, Mullen,

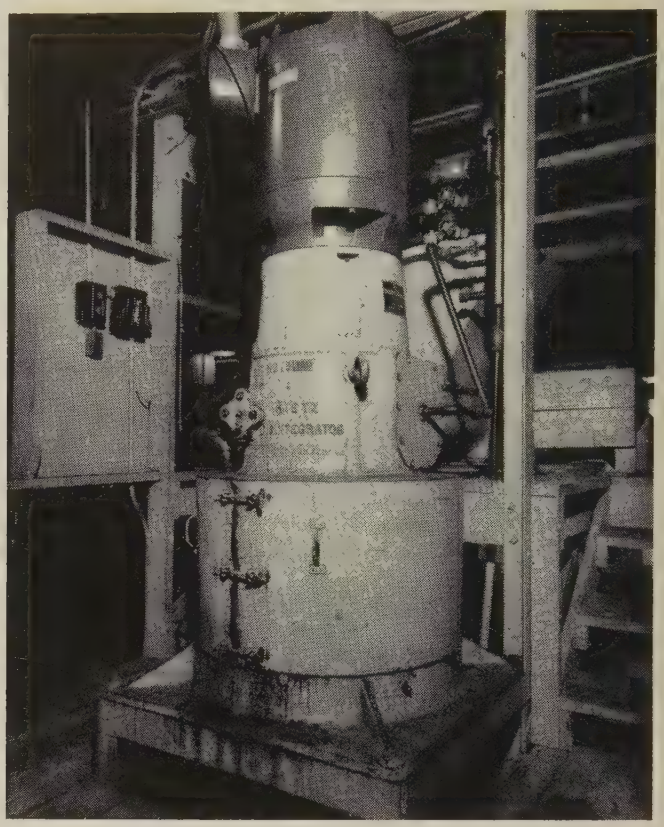

Fig. 6. Reitz disintegrator

Photovolt brightness tester, and a Hinde and Dauch crush tester. Of special interest is a Sjostrom Projektina (Fig. 22) recently adapted for fiber dimension and sheet formation studies.

A library is an essential part of any investigation to provide up-to-date information and prevent unnecessary duplication. Figure 23 shows a scene in the library.

The Herty Foundation is a trusteeship of the State of Georgia. It obtains some funds from the State Division of Forestry, which have been used primarily, in recent years, for capital improvements. It renders service to industry on a cost and confidential basis. Costs are computed on the

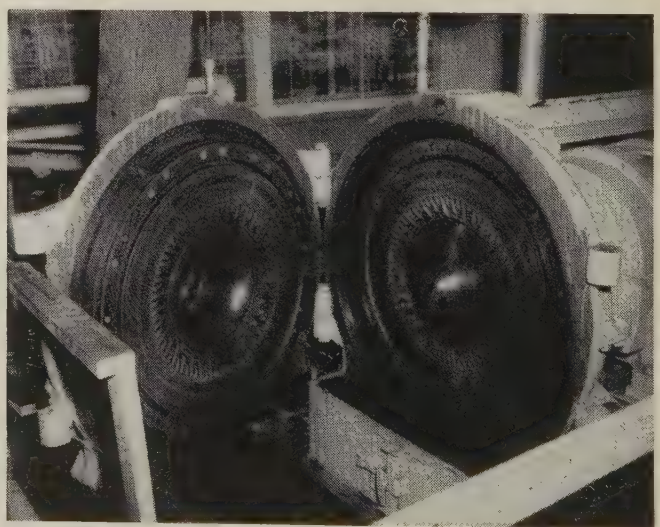

Fig. 7. Sprout-Waldron 36-2 refiner with plates open

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Every feature of a Farrel two-wheel roll grinder has been designed to give you that extra accuracy you need for grinding the long rolls used in paper mills.

The swing-rest method of mounting the grinding wheels offsets any effect on roll accuracy which might be caused by the ways being slightly out of parallel as a result of distortions in the machine bed from seasoning, temperature changes, settling of foundation, etc.

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The grinder bed is made of Farrel Meehanite® metal, a special processed cast metal combining many of the best properties of cast iron and steel. Meehanite is an ideal metal for bed casting because of its superior vibration-damping qualities. The carriage, which is also made of Meehanite, is of rugged construction with the ways cast integrally. On the carriage is mounted the swing-rest unit, supported on knife edges. The swing-rest carries the two grinding wheel units, including sub-bases in adjustable pivot supports.

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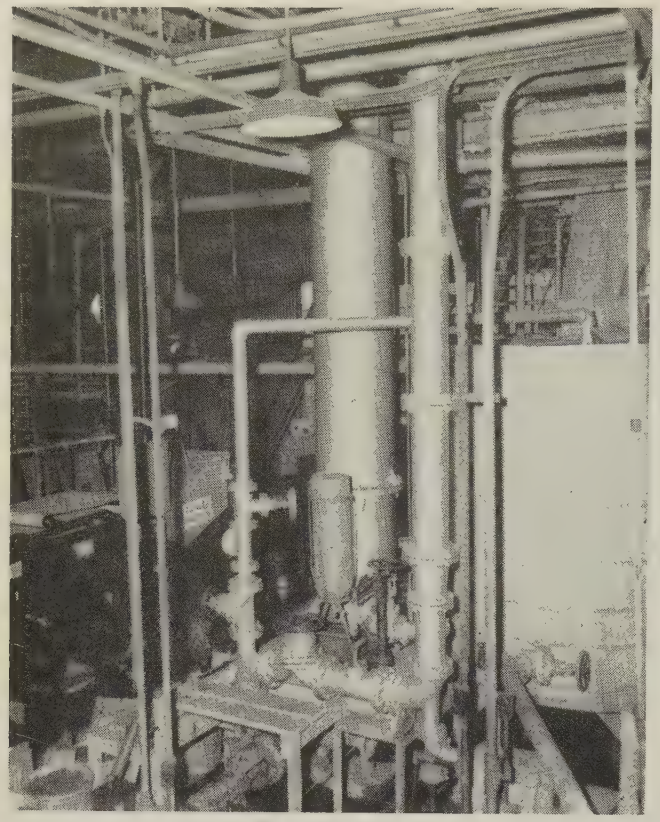


Fig. 8. Hooker chlorinator

basis of time for use of the pilot plant or pro-rated time of employees concerned with a client's particular problem.

Underlying the laboratory's philosophy is the concept of *putting research knowledge to industrial use as promptly as possible.* The over-all end product sought is broader and more complete utilization of trees, agricultural fibers, and fibrous wastes. The phenomenal growth of the paper industry in the south is evidence of the sound vision and courage of Charles Holmes Herty, the Laboratory's founder, and those who nurtured its infancy and persisted when less courageous people predicted failure.

Additional benefits accrue to clients who wish to have their personnel gain practical pulp and paper mill experience by working at the laboratory. In several instances, during a few weeks' cooperative work at Herty, inexperienced personnel have become familiar with practical problems and are much better qualified on their respective jobs. A cooperative

Fig. 9. Hollander beaters

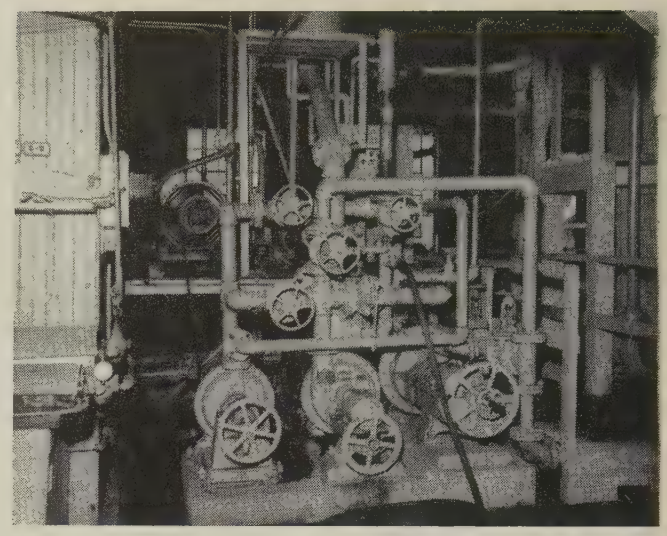


Fig. 10. Hermann Claflins and Jones pony jordan

arrangement may be made with any company or institution wishing this experience with its employees.

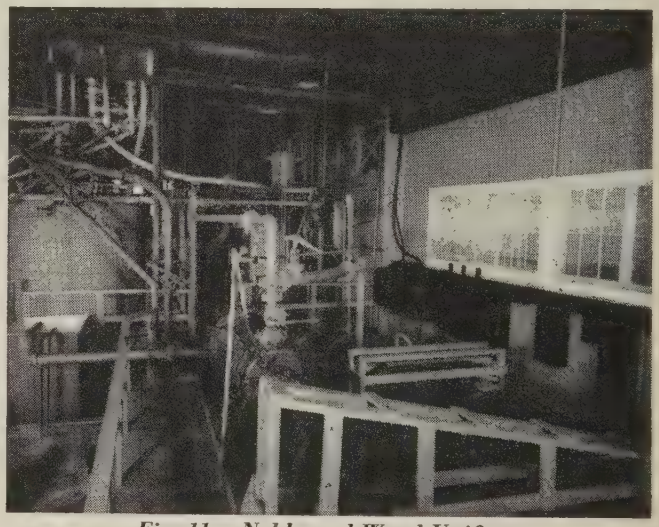


Fig. 11. Noble and Wood Unifiner

Some notable results of the laboratory's studies of the last 2 years include the following mills in some stage of construc-

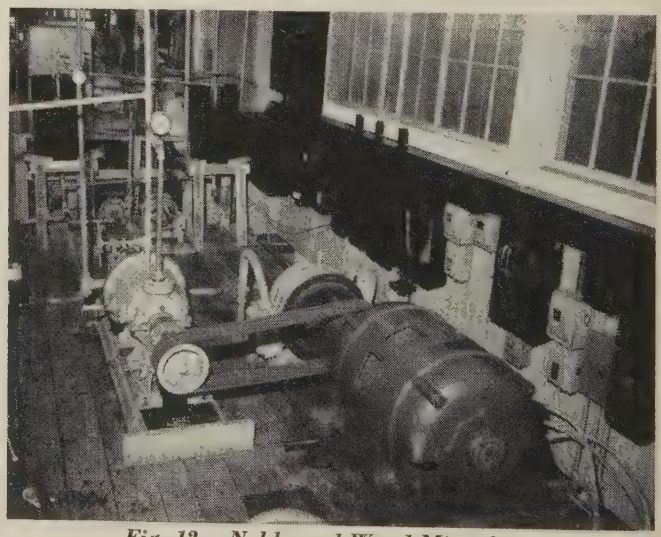
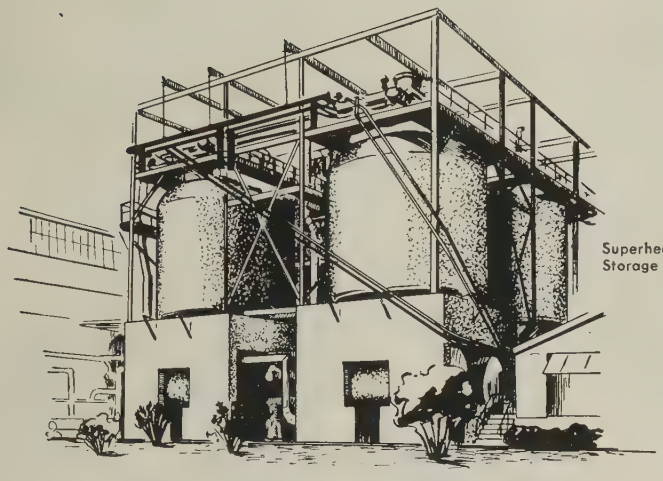


Fig. 12. Noble and Wood Microfiner



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- **MOSS BLUFF, TEXAS**
- **SPINDLETOP, TEXAS**
- **WORLAND, WYOMING**

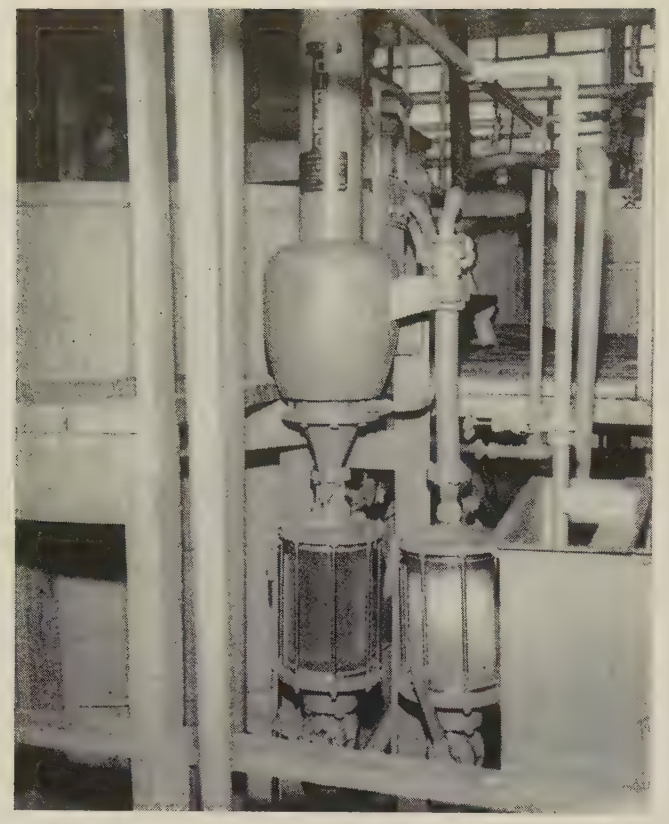


Fig. 13. Bird Dirtec

tion, modification, or anticipation: one to make specialty papers from bagasse, one to utilize Philippine mahogany in newsprint, one to utilize hardwoods as semichemical and groundwood in newsprint, one to manufacture glass paper, one to develop special properties from hardwoods for use in wall-

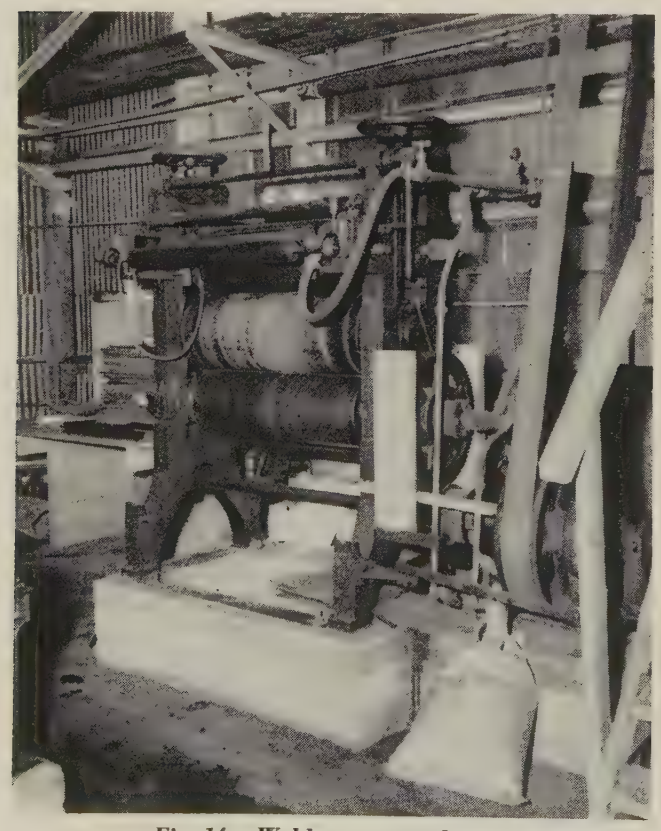


Fig. 14. Waldron supercalender

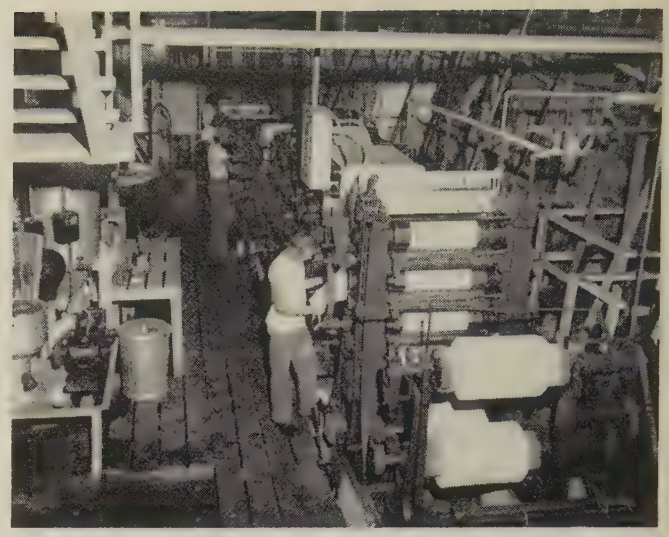


Fig. 15. Fourdrinier pilot paper machine

boards, several to utilize semichemical pulps in packaging and container products, several to recover and utilize waste

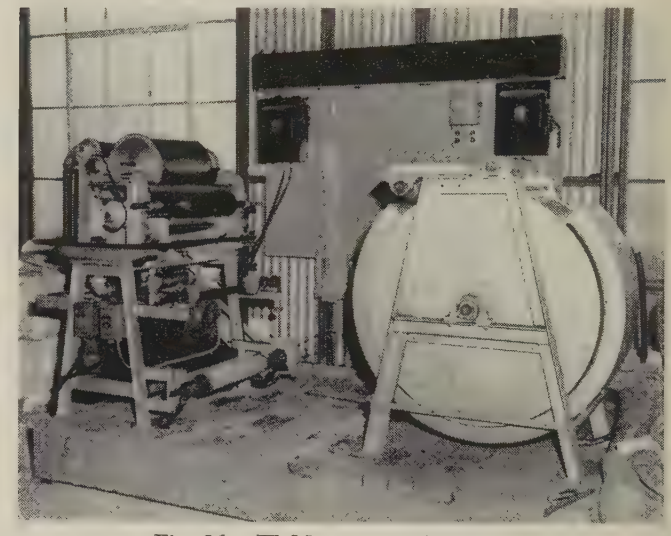


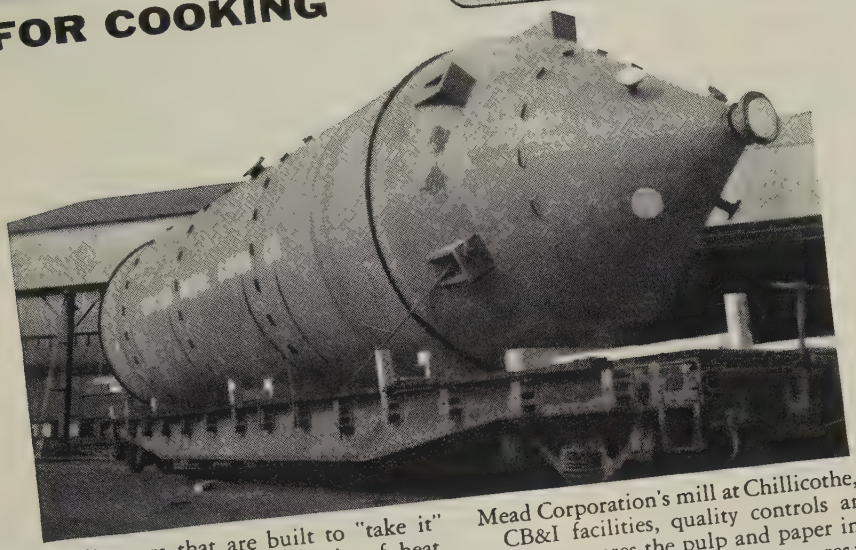
Fig. 16. Waldron microjet coater

papers. Also included are a variety of changes in bleaching, refining, purifying, and manufacturing which do not require

Fig. 17. Noble and Wood pulp evaluation

RECIPES FOR PULP MILLS...

FOR COOKING



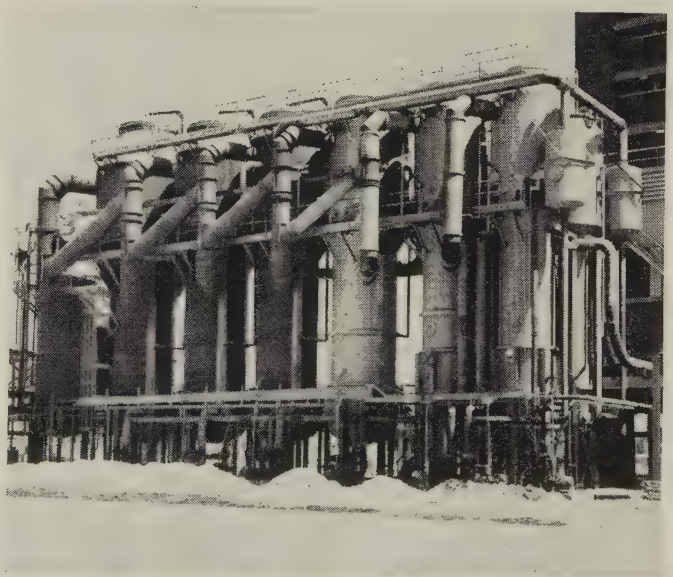
Pulp digesters that are built to "take it" under the constant working strain of heat, cooking liquor and pressure. Shown above is one of four 11-ft. 7-in. diam. by 51-ft. 10½-in. digesters that were built for the Mead Corporation's mill at Chillicothe, Ohio.

CB&I facilities, quality controls and experience assures the pulp and paper industry the best in welded steel plate structures to keep pace with new processes and greater demands.

FOR EVAPORATING

Conkey Sextuple Effect Evaporator, code construction throughout, operating on sulphate black liquor. Other Conkey equipment helping solve pulp mill evaporation problems include:

- Conkey Integral Evaporators (Long Tube Climbing Film Vertical Type)
- Conkey Long Tube (Film Type) Vertical Evaporators
- Conkey Forced Circulation Horizontal Tube Evaporators
- Conkey Channel Switching (Rosenblad Patents) Evaporators



Write our nearest office for information on Horton digesters, Conkey evaporators, and other CB&I welded steel plate structures. Estimates or quotations will be supplied upon request.

CHICAGO BRIDGE & IRON COMPANY

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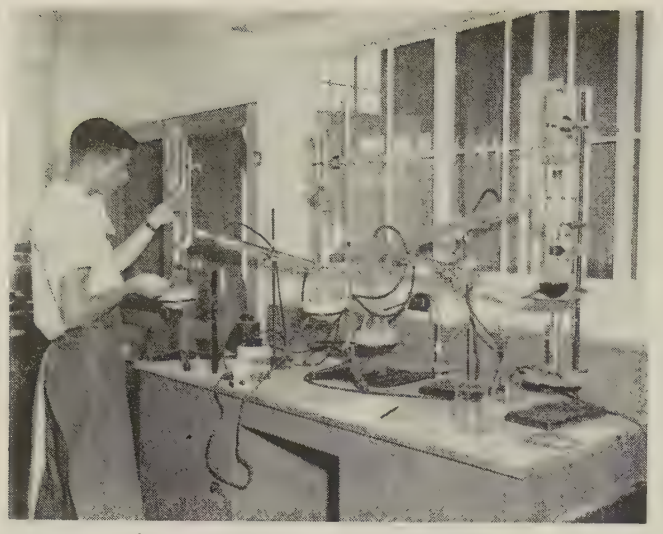


Fig. 18. Pentosan determinations

Fig. 21. Controlled humidity test room

equipment changes in the mills. Information about results is generally confidential and is released only by the client, thus more details on the above are not presently available for publication.

It may be concluded that a well-equipped pilot plant laboratory for pulp and paper applied experimental work is available to industry at the Herty Foundation in Savannah, Ga. This laboratory can be profitably used to coordinate and interpret research results in terms of manufacturing experience.

Fig. 19. Titration of cooking chemicals

Fig. 22. Fiber dimension equipment—Sjostrom Projektina

Received March 1, 1954. Presented at the 39th Annual Meeting of the Technical Association of the Pulp and Paper Industry, New York N. Y., Feb. 15-18, 1954.

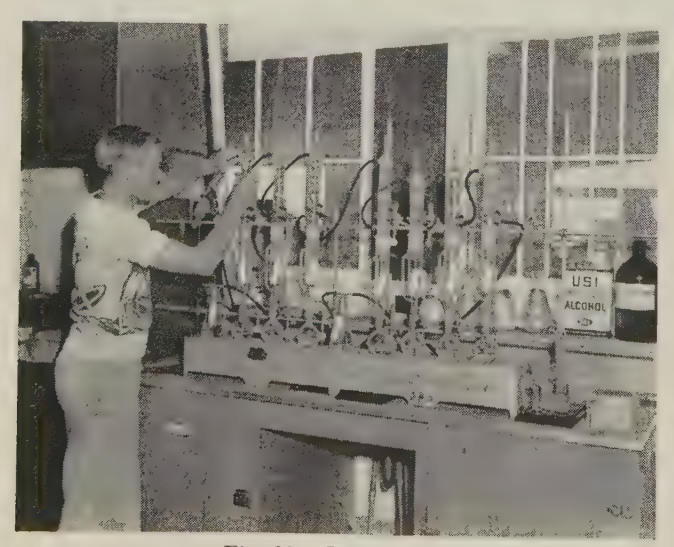
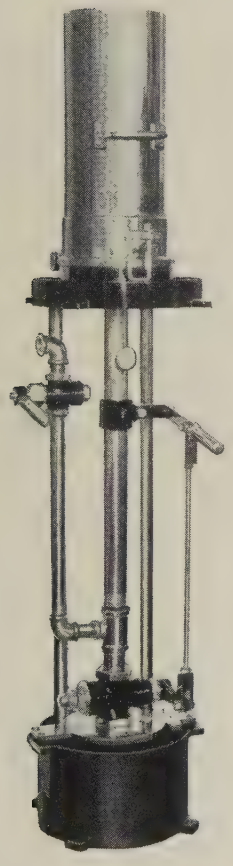


Fig. 20. Extractions

Fig. 23. Library scene

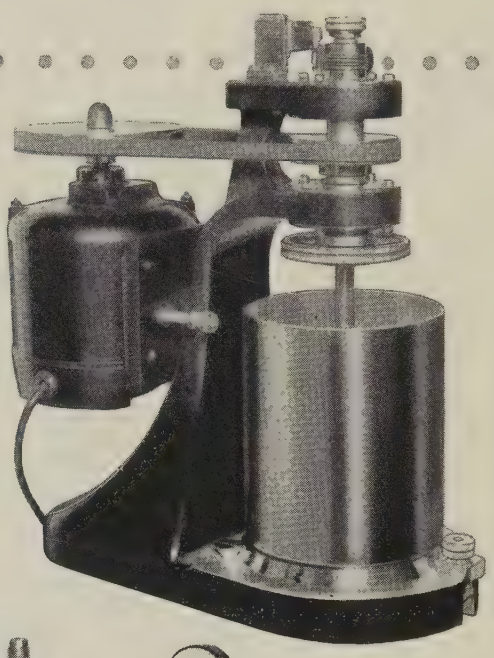
TAPPI STANDARD

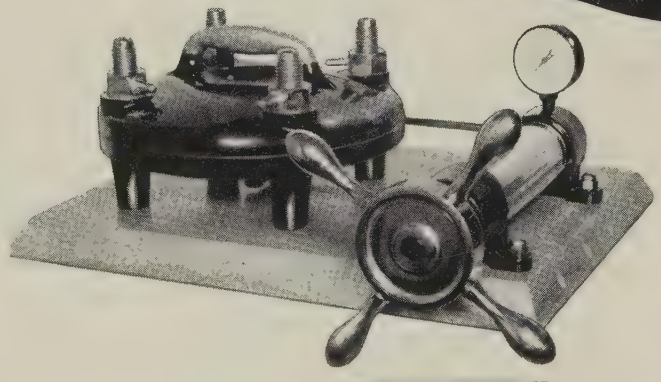
Pulp Testing and Sheet Making Apparatus



TAPPI Sheet Making Machine

TAPPI Disintegrator





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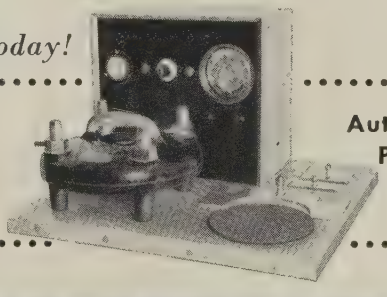

Automatic Press

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LANCASTER, OHIO

Prohibited Materials and Outthrows Found in Paper Stock*

HENRY J. PERRY

THE producer, collector, distributor, and user of paper stock is continuously plagued by rejections, adjustments, and lost production time caused by the inclusion of "outthrows" and "prohibited materials."

The terms "outthrows" and "prohibited materials" are apt to be confusing because a material *prohibited in one grade in any amount* is *allowable in small amounts* in a lower grade, as outthrows.

The accepted definitions, as defined by WP-54 of the Waste Paper Institute, are:

"OUTTHROWS are all papers that are so manufactured or treated or are in such form as to be unsuitable for consumption as the grade specified."

"PROHIBITED MATERIALS are: (A) Any materials which, by their presence in a packing of waste paper, in excess of the amount allowed will make the packing unusable as the grade specified. (B) Any materials that may be damaging to equipment."

The ideal condition, of course, would be no "outthrows" or "prohibited materials" in any grade. However, economic factors prevent complete elimination. Thus, the Waste Paper Institute in WP-54 has set the practical maximum allowable amounts of "outthrows" and "prohibited materials" by grades.

The following list outlines "prohibited materials and outthrows," their most common sources, and the reasons they cause trouble. Their elimination by sorting, segregation, and modification will do more to increase the paper stock consumed than any other practical means. Many of these materials must be eliminated at the source because no other practical method exists.

When there is any doubt about a material it should be checked by the ultimate consumer, *the paper or paperboard mill.*

TWO SIMPLE TESTS

A General Test

A rather simple identification test for some prohibited materials, used by several mills and which could be most helpful to other mills and sorters alike, is:

Set up a small hot plate. Keep a stainless steel or enamel 2 or 3-qt. basin or kettle, two thirds full of 1% caustic soda solution, on it. The solution should be hot (just under boiling—160 to 180°F., is hot enough). Any suspicious paper can be dipped into the solution for up to a minute.

1. If the coating, adhesive, or ink dissolves or goes to pieces, it is *very unlikely* to cause trouble in deinking.
2. If the material gets sticky, melts, gets stringy, or remains as is, it is *more than likely* to cause trouble.

Wet-strength papers will show up because they will remain strong. Nonwet-strength papers will fall apart easily.

If the solution gets on hands or fingers, wash it off promptly.

This is a relatively simple test, reasonably safe, and very quick to use. All of the items are easy to obtain. It is surprising how simple it is to use and how well it works.

A board mill could use hot water only and stop a lot of trouble right at the pulper or beaters.

A Quick Test for Wet Strength

A primary test for wet-strength paper is the Jayme-Brauscheid phenyl hydrazine test. Details are contained in Waste Paper Utilization Council Bulletin No. 19.

In simple form, apply a drop or two of 1% phenyl hydrazine sulphate in 40% sulphuric acid to a suspected wet-strength paper. Wait 30 sec. until it has been absorbed and add a drop or two of 10% ferric chloride solution. In 3 min. or less, a red color indicates a wet-strength resin containing formaldehyde. Probably 90% of all wet-strength papers contain formaldehyde.

It should be noted that this test is no indicator of how easily a wet-strength paper will break up.

SOURCES OF OUTTHROWS AND PROHIBITED MATERIALS

In listing these sources, it must be remembered that not all of these papers or products contain materials falling into the "prohibited class." This summary gives most likely places where "prohibited materials" may be found.

Wet-Strength Papers

The growing use of wet-strength papers is of increasing concern to the user of paper stock. It poses a difficult problem because rather elaborate tests are required for identification. However, if wet-strength papers are segregated and are so known, they can be used if specially treated. The major complaint is the contamination by small to medium amounts of high wet-strength papers.

The primary wet-strength papers that cause trouble are:

BAGS: This group includes plies in multiwall sacks, grocery bags, and various specialty bags, potato, corn, and ice sacks; and tea bags.

MAPS: Armed forces maps and charts of various kinds.

TICKETS, LABELS, TAGS, ETC.: Tickets used by laundries, dry cleaning establishments, and other industries where exposure to washing and cleaning is part of processing or where outdoor exposure is common.

BLUEPRINT PAPER: Construction drawings.

CRATE LINERS for lettuce and other fresh vegetables.

TWISTING TISSUE AND PRODUCTS.

WRAPPERS: Wrappers for various packages of foods which are moist or wet. These papers may be unbleached kraft or bleached papers used for any wrapping purpose, including fish, meat, and fresh vegetables, locker papers, oleo, butter, and lard.

HOUSEHOLD PRODUCTS: Dusters, furniture polishers, paper dish cloths, cellulose sponges, etc.

PHOTOGRAPHIC PAPERS.

V-BOXES.

Nondefibering Papers

Glassine, greaseproof, and vegetable parchment papers, which have been mechanically or chemically treated, can generally be identified by appearance.

The major uses are: ENVELOPE WINDOWS, LAMP SHADES, MOIST AND GREASY FOOD WRAPPERS used in cheese, butter, and lard industries. They may be laminated in cartons or sometimes used for envelopes for packaging oily or greasy metal parts. Greeting cards are sometimes made from these types of papers.

A general characteristic is short or no fiber length when torn and some transparency. Heating with a match flame will make blisters in the paper and is a quick easy test.

Waxes

A wide range of waxes is found in paper stock. The major source of wax comes from paper converting plants. Stock originating in financial institutions may contain seal-

HENRY J. PERRY, Waste Paper Utilization Council, New York, N. Y.

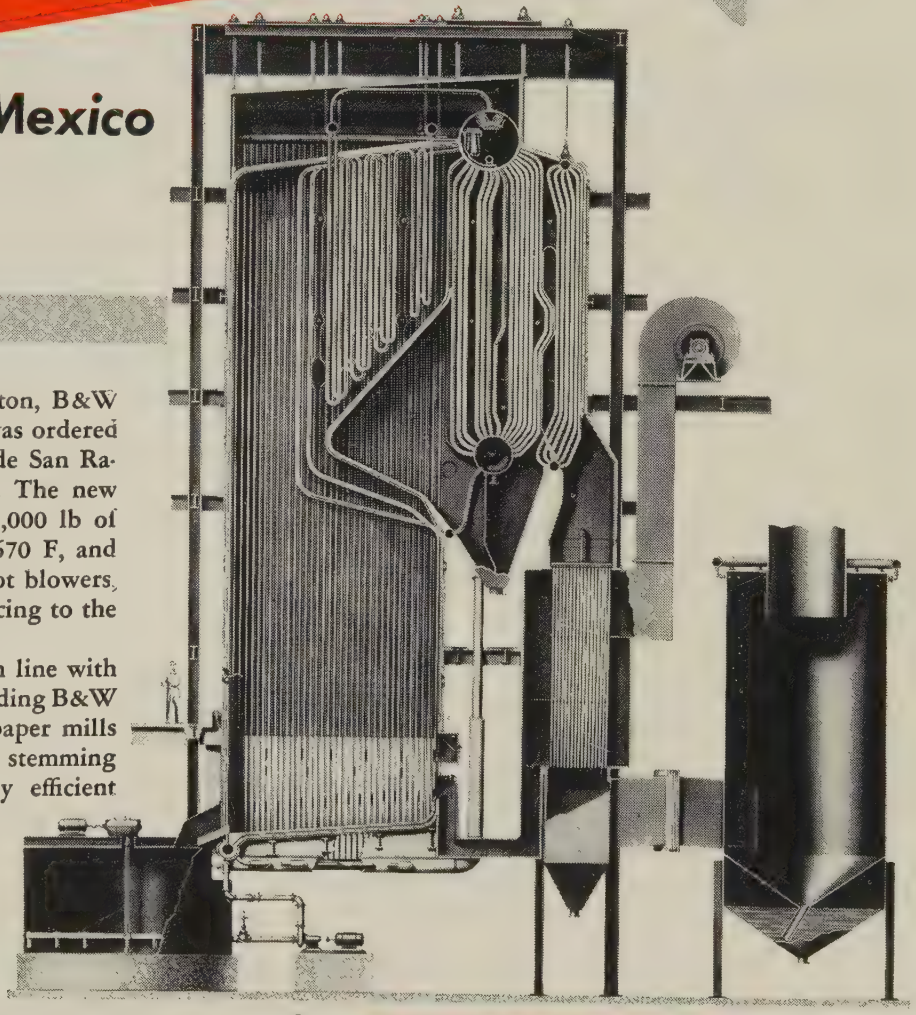
* The content of this article represents the opinion of the Waste Paper Utilization Council concerning "prohibited materials" and "outthrows" found in paper stock. Nothing contained in this listing is a criticism of any paper, paper product, or any other material as related to its primary function. Any discussion or listing is made for the sole purpose of aiding in the conservation and proper reuse of paper stock as a source of papermaking fiber.

# of B&W Recovery Units REPUTATION GOES A LONG WAY

. . . to Mexico

"South of the border," a 66-ton, B&W Black-Liquor Recovery Unit was ordered recently by Fabrica de Papal de San Rafael y Anexas, S. A., Mexico. The new unit is designed to deliver 31,000 lb of steam per hr at 475 psi and 670 F, and is equipped with automatic-soot blowers, which reduce routine hand-lancing to the minimum.

Destination of this unit is in line with a developing pattern that is sending B&W Recovery Units to pulp and paper mills in all parts of the world . . . stemming from a reputation for highly efficient chemical and heat recovery, with low-cost operation and maintenance, that has been service-proved since 1935.



Typical B&W 2-Drum Recovery Unit equipped with B&W Cyclone Evaporator

BABCOCK & WILCOX
BOILER DIVISION

P-776

ing wax. Household and school collections often contain wax crayons. Wax will dissolve in lighter fluid or carbon tetrachloride.

Asphalt and Tar

No one material so completely destroys the value of paper stock as asphalt or tar. Its waterproofing and adhesive properties plus low cost make it extremely common in paper converting. Principal sources are:

Multiwall Sacks.

Insulated Bags for frozen food, ice cream, candy or small item mailings, often found inside of folded news.

Roofing, Building Papers, and Shingles.

Waterproof Papers, used in roll wrapping and case liners in paper shipping and for other weather protection.

V-Boxes.

Adhesive used for sticking two sheets of paper or board together; foil or various films in envelopes, bags, cartons, cases; and various special wrappers.

Cheap Suitcase Liners often use asphalt adhesive.

The so-called Tar Strips on corrugated boxes are a common source.

Furniture Padding.

Creped or Crinkled Papers are often asphalted. Sometimes they are decorated with designs or trade-marks on one side.

Asphalt can be identified because it is black or dark brown in color and sticky. Dunking in kerosene shows up asphalt. Cigarette lighter fluid or carbon tetrachloride will do the same thing. Any black or dark brown papers, or papers with a black center when torn, are suspicious and should be checked for asphalt.

Dirt

Ashes, cinders, floor sweepings, coffee grounds, and miscellaneous trash are easily identified.

Wood

Wood in any form, such as: Excelsior, Sawdust, Printing Furniture, Miscellaneous Scraps, Furniture Padding, or Pencil Sharpenings is prohibited.

Nuts and Nut Shells

Nut meats are almost impossible to remove. They not only cause specks and dirty papers, but oil spots as well. Nut shells cause dirt. The hard type makes holes in paper when crushed, scratching printing plates and causing general rejection.

Tobacco

All forms of tobacco are found, ranging from ashes, old butts, and chews. They cause general dirt specks because of impossibility of removal.

Rubber

Rubber is found as rubber bands printing plates, belting, old foot wear, and other items. It cannot be removed from paper mill systems as it is cut into fine pieces and shows up as dirt and lumps which interfere with printing and high quality.

Waxed Paper Products

Practically every paper cup and container is waxed for additional waterproofness. Waxed paper is used for bread, candy, and other food wrappers. Industry also uses waxed paper for packaging metal parts, interleaving, and separators. Wax is used for making paper transparent, such as for envelope windows. Generally wax can be readily identified by the appearance and slippery greasy feel. Principal products to watch for are: Cups and Containers, including milk bottles and caps; Frozen Food Wrappers and Cartons; Candy, Gum, and Food Wrappers; Cartons for butter, lard, oleo, and cheese; Tissue Paper from machine shops and machinery assembly plants, Bread and other food wrappers, old lunches, etc.; Any Wrappers With Metal Foil or Plastic Films in combination with paper; Waterproof Wrappers; and Drinking Straws.

Waxed paper and products are similar in some respects to wet-strength paper. The contamination by small amounts included in paper stock is a serious problem because of resulting transparent spots, plugged wires, etc. On the other hand, packs of all waxed paper and products can be treated by some mills to produce excellent fiber when economic conditions warrant such treatment.

Synthetic Resin or Plastic Coatings

Any paper with a shiny coating or embossed with a design after a coating is suspicious. These coatings do not break up, and scatter flakes throughout papers and paperboard. They are tough, flexible, scuff resistant, and waterproof.

Principal sources are: Book Covers, Booklet Covers, Various Report Covers, Special Advertising Pieces and Displays, School Note Books, Carrier Sheets for casting plastic film, Decal Sheets for plastic printing, and Facsimile Transmission Papers, aluminum coated one side lightweight black photographic base paper, other side dull light gray.

If the coating washes or rubs off with water, it can be used in paper stock. If the coating gets sticky in acetone, methyl ethyl ketone, or a similar solvent it will cause trouble.

Plastic Saturated or Impregnated Papers

Paper saturated with rubber, latex, or plastic emulsions to improve tearing resistance, folding strength, and useful life is prohibited.

Principal sources are: Book Cloth; Note Books; Artificial Leather Items; Shoe Materials; Gaskets; Arm Bands used for civil defense, etc.; Filter Papers and Pulp for plastic solutions; and Specialty Papers, such as special battery tags, special children's book paper, maps, technical and training manuals for armed services.

Burning and smelling a sweetish or rubber odor will identify a troublesome material. Often lighter fluid, carbon tetrachloride, or methyl ethyl ketone will make the material sticky. High tearing strength is an indicator.

Garbage

Old food is constantly found in many grades of waste collected from households, offices, and industrial plants. Not only is it not waste paper, but it creates odor and many other problems.

Metal Foils

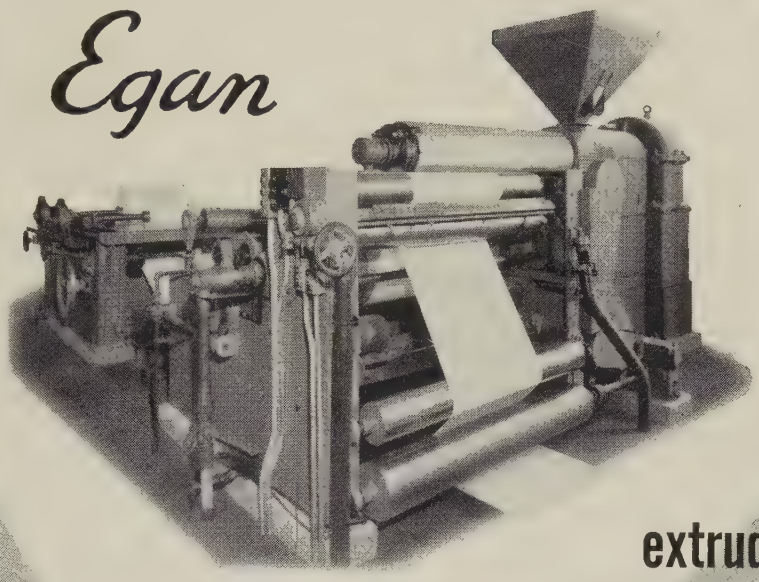
The use of metal foils in combination with paper is a growing market. These combinations are used for protection of contents, attractive displays and for insulation value. In some cases foil alone is used in competition with paper as a wrapper.

Principal uses are: Display Boxes, Corrugated Cases for frozen food, Milk Bottle Caps, Insulation and Building Papers, Greeting Cards, Food Wrappers of many kinds, and Advertising Displays. They are relatively easy to identify because of a bright shiny surface.

Plastic Films

Many transparent plastic films are produced in a wide variety of colors and decorations. These films are common to everyday living as Repairing Tapes; Bags for all varieties of packaging; Window Envelopes; Christmas Wrappings, and Food Product Use, glued to paper and board for protective and decorative purposes; sometimes used on Pocket Book Covers.

Egan



polyethylene extruder-laminator

(Above pictured installation at the Milford, N. J. plant of RIEGEL PAPER CORPORATION)

COMPLETE PACKAGED MACHINE

Combining in one unit, in engineered balance, two famous units—The Egan Extruder and the Egan Laminator. Planned for your current—or expanding—production, available in varying sizes—from 24" Pilot Plant Size to 96", 1000 feet per minute continuous operation. Machines are capable of coating on paper and paperboard, cellophane, foil, glassine and cloth.

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Approximately 75% of all polyethylene extruder-laminating machines now in operation anywhere in the world are Egan Equipment.

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All are insoluble in papermaking systems.

When these films appear in any volume glued to paper or board or as envelopes or bags, they are a problem not only because of loss in usable stock but defibering breaks them up into small pieces which pass through the screens and cause rejected papers.

Furthermore, rubber cement is often used as the adhesive, which in turn causes rejection of paper and board.

Any shiny, glossy, smooth, transparent material, colorless or in bright colors can be a plastic film. Some are soluble in previously mentioned solvents, but many are not.

Oil and Grease

Paper and boards used as wipers and containers for grease and oil are a common source of transparent spots in paper and board. These materials also gum up paper mill equipment.

Certain oils, especially those used in the paint industry can be a serious fire hazard if included in baled paper stock.

Sand, Ground Stone Products, Other Water-Insoluble Powdered Materials

With the increasing use of all types of sacks and their unlimited horizon, various insoluble powdered materials remaining in bags are an increasing problem. Thus, sacks used for: sand, cement, dry pigments, lime, plaster, chemicals, insecticides, ground or powdered plastics, or sulphur have no place in waste paper grades other than in their own special grade, "Old Chemical Bags." Even in this grade, the board mill should be consulted before shipment for usability. Usability depends on individual mill equipment and grade of board produced.

Some stock cleaning methods can remove many of these items. Some products however defy removal.

Rubber and Latex Cements

Rubber latex cements and their synthetic cousins are all too common for the comfort of the paper mill operators. The materials occur most often in Self-Seal Envelopes, Crinkled and Creped Paper, Bags, Linings and Wrappers, Cellulose or Plastic Tapes, Padding Cements in padded business forms, Tablets of Paper, Self-Sticking or Pressure-Sensitive Signs and Labels, Posters and Displays, Various Printers' Dummies and Galleys Art Work, Office Waste, Certain Banding Tapes and Strips used in laundries use latex to hold the ends together when banding shirts, and Flying Pasters used in high-speed magazine printing are almost pure rubber.

Latex cements are becoming quite common for roll headers and end bands in roll wrapping of printing and fine papers. Certain bags are made with latex-type cements as the adhesive.

Splices used in paper mill rolls for special conditions and easy application often are rubber base.

Leather

Occasional pieces of leather occur in paper stock. While leather is fibrous and is the base of leather heeling board, it has no place in paper stock.

Printers' Ink

Dried films of printing ink generally offer few problems, except in cases of unusual or nondispersible types. However, Ink Fountain Wipers, so-called Ink Wads or Globs, and Ink Can Covers are prohibited materials. Inks in their wet and sticky form pick up dried ink specks and form soft, gummy ink balls which defy removal, causing black spots and streaks.

Printers' Proofs, "Make-Ready," and other sheets with heavy films overload deinking systems.

Solid Printing and Reversed Printing, when in large quantities, are equally troublesome.

Fluorescent Inks and Coatings, such as daylight signs and glowing displays are not desirable. They produce colored flakes and specks.

Inks used in thermographic processes melt and stick on paper machines, making colored or black specks.

Burned, Charred, or Sunburned Papers

Burned or charred papers result in low yield. However it is the black carbon which degrades high whites and lower brightness that is objectionable. These papers do not defiber readily and specks and flakes are most objectionable in the finished product. The burnt odor may carry through to the finished product.

Any papers that are sunburned to a noticeable degree are generally high groundwood content papers. Sunlight and heat destroy the strength and lower the yield of usable fiber.

Paint

Paint, with its various resinous binders, shows up as colored and metallic specks. The pigments and colors are not bleachable, causing off-color and low brightness.

Common sources are Sample Paint Cards, collected from stores, household, printing concerns, and paint manufacturers.

Textiles, Rags, Rope, Twine

While these materials are papermaking fibers in raw form, the treatments required to prepare them are drastic and beyond the facilities of paper stock users.

Their inclusion in paper stock is a dead loss, besides a source of long hairs, rubber, specks, tar, and dirt.

Odor

Any odor is a problem. *Any pronounced odor is objectionable.*

Other Adhesives

A wide variety of glues is used in paper converting and binding. Most of them have been covered under rubber or latex adhesives, because of their similar characteristics.

Hot melts, used in bookbinding, have been most troublesome. However, since 1953 they have been modified so that they are not objectionable to deinking plants. However, board mills might find them objectionable because they are not water soluble.

Hot melt binding adhesives might be found in Flyleaf Shavings, Printers' Waste, So-Called Pocket Books, and some magazines printed prior to January, 1953.

Padding cements used by printers and stationery manufacturers can cause trouble. Sticky and gummy specks are the result. Waste from printers and stationery manufacturers could contain troublesome cements. Items found in ledger grades of stock, such as Business Forms and Income Tax Forms may contain insoluble or rubbery cements. If such a binding is rubbed with a wet finger and gets sticky, it is water soluble and usable.

Heat Seal Labels and Wrappers. A variety of heat-seal coatings are available for automatic labeling and wrapping machines. Some of these heat-seal adhesives show up as waxy surfaces, some dull-like coatings, and other similar in appearance to gummed tapes. None of them gets sticky when wet with water. All require the heat from a match or cigarette lighter to develop their stickiness.

Principal sources are: Candy and Food Manufacturers, Pharmaceutical Bottlers, Pharmaceutical Manufacturers, Individual Sugar Packets, Some Business Systems attached forms to file folders with heat-seal adhesives, often used by insurance companies.

The Buffalo Electro-Chemical Company, Inc. and the Becco Sales Corporation have been merged with Food Machinery and Chemical Corporation. Effective January 1, 1955 they will operate as "Becco Chemical Division", Food Machinery and Chemical Corporation.

The personnel with which Becco customers are familiar will continue to operate Becco Chemical Division. Customer service, research and production will prevail at the same high level as for more than 25 years past.

BECCO® BRIEFS

HIGH DENSITY PULP BLEACHING

Continuous hydrogen peroxide bleaching at 25-40% density is increasingly used for groundwood and chemical pulps in crumb or sheet form. High density operation has reduced chemical cost and floor area requirements. Groundwood bleaching is now more efficient than ever. Chemical and semi-chemical pulps are super-bleached to high brightness with improved aging characteristics not otherwise attainable. For detailed information write for Becco Bulletin No. 48.

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Sulphur

Certain paperboard products may contain sulphur. This material is sometimes used as a stiffener for corrugating medium or as a dusting to prevent sticking of synthetic rubber to a shipping container. Agricultural or rubber chemicals may contain large amounts of sulphur.

Burning a small piece and smelling of the smoke will quickly identify sulphur.

Glass

The inclusion of any form of glass creates an accident problem for the sorter packer, and paper mill employee. In addition to injury to persons, glass is damaging to paper mill equipment and causes direct financial loss as it has no salvage value and at best can be classified as expensive land fill.

Floor Coverings

Enameled floor coverings, linoleum, cork blocks, plastic and asphalt tiles are a source of asphalt, cork, sawdust and gummy spots.

Glitter

Various small particles of tinsel, metal and plastic foil, sawdust, and various colored fiber flocs used to simulate grass, fur, etc., used on greeting cards contaminate paper stock and cannot be removed after defibering

MARKING SYSTEMS IN USE

It should be noted that several marking systems are in effect which identify wet strength, asphalt, polyethylene films, sulphur, and other troublesome materials.

Members of the Fibre Box Association are marking boxes using

Asphalt

Sulphur

Polyethylene

in their construction, on the bottom flaps as a means of identification.

Wet-strength papers used in shipping sacks are required to be striped by the Railroad Uniform Freight Classification Rule 40, Sec. 10, Note 2,

"Wet-strength paper must be distinctly colored, stained, printed, or marked for identification with longitudinal stripes spaced not less than 2 in. nor more than 10-in. centers across the width of the paper and each stripe must be not less than $^1/_3$ in. in width. No other grade of paper used in bags shall be striped in this manner. When wet-strength paper is used, the identification must appear on the external surface."

No mention is made concerning the color of the stripe. *It, therefore, can be any color.*

The Paper Shipping Sack Manufacturers' Association, Inc., has recently revived its original ANK (all natural kraft) marking program. They are promoting this system, through the use of an $8^1/_2$ by 11-in. poster designed for bulletin board posting in all paper shipping sack factories and for distribution as envelope stuffers to salesmen and their customers.

This symbol

will mean any sack bearing this label is usable as paper stock.

The poster will warn against the use of the ANK symbol on paper sacks containing any: bleached kraft; colored kraft; asphalt laminated kraft; impregnated kraft such as scutan; polyethylene coated kraft; waxed coated, impregnated, or laminated kraft; wet-strength kraft; or any treated papers which are non water-soluble.

Also, that the ANK symbol should not be printed on paper sacks made for such commodities as insecticides, benzine hexachloride, beta naphthol, graphite, sulphur, plastics, resins, rosins, paint, rubber, wax asphaltic compounds, greases, or products which will not dissolve in water or which may impart strong odor to repulped stock.

The Paper Shipping Sack Manufacturers' Association, Inc., advises that the ANK symbol is to be printed only at the option of the customer. It is promoting this marking system to assist the ultimate consumer in obtaining the maximum salvage value for used sacks. The symbol when printed will appear near the freight classification certificate.

QUALITY ASSISTANCE PROGRAM

The Waste Paper Utilization Council is a nonprofit organization, supported by paper stock consumers, distributors, generators, and graphic arts suppliers, devoted to increasing the use of paper stock. Its facilities are available for the improvement of waste paper quality.

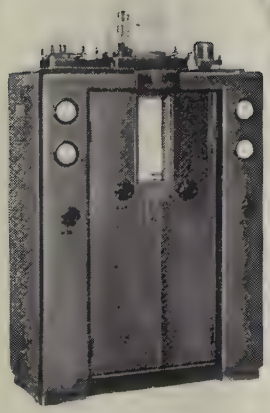
PAPER

KEEPS COMING...

...AND COMES

CLEAN

WITH W&T CHLORINATION



No slime formers . . . no contaminating organisms . . . no objectionable tastes, odors or colors . . . paper keeps coming without a slime break, and comes *clean* when a Wallace & Tiernan Chlorination system safeguards the fresh and white waters.

Whether your mill produces pulp, newsprint, kraft, writing, tissue, or board, the quality of your product and the efficiency of your mill depend on clean, biologically pure water. For information on how to get biologically pure water most economically, write our Industrial Division.

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CORN STARCH

to fit your every need

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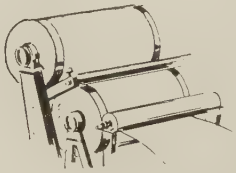
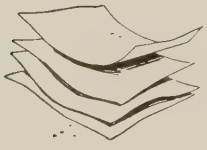
BEATER ADDITIVE

Our Amijel Brand Corn Starches are thick-boiling, pre-gelatinized starches highly preferred because of their increased cold-water dispersibility. They are widely used in the manufacture of specialty board and paper of high quality.



SURFACE SIZE

Our Eagle Brand Pearl Corn Starch is a popular starch for surface size. It is a thin-boiling starch of high fluidity. It is recommended for its desirable surface film-forming qualities and its uniformity.



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A full line of dextrines and gums is available to meet all bonding and adhesive requirements. Our Lam-o-dex brand dextrines produce tough bonds resistant to separation. Several grades are offered, their particular use depending on the porosity of the board being used.

CORRUGATING ADHESIVE

Our Globe Brand Pearl Corn Starches and Coragum Starches... thick boiling starches are popular with corrugators. They yield low spread figures plus good bonding properties.

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Load Meters, Tension Meters, and Torquemeters for Paper Machines

J. C. HARPER and T. A. McARN

In order to produce paper and board to meet the specifications and requirements of the consumer, it is important that machine variables be closely controlled. Satisfactory instruments for the control of wet-end variables have not been available, with the possible exception of stock preparation controls. The concept and development of the load meter provide a simple, accurate, and rugged method for measuring, recording, and controlling press roll loading, or other load points where uniform loading is important. The load meter employs the established principle of the Wheatstone bridge circuit to detect minute variations in the stress on a steel column. A slight change in load on the column results in a proportional change in flow of a small electric current. This current is in turn employed, by means of suitable instruments, to indicate, record, or control the applied load on the press. The load-sensitive unit is hermetically sealed and contains no moving parts. Variations of the load meter system have been employed in similar arrangements to measure felt tension, refiner thrust loads, and fourdrinier wire tension.

DESIGNERS and builders of papermaking machinery have always been dependent to a considerable extent on mill operational history for data to be used as a basis for improved designs. Until recently, much of these data were inaccurate or incomplete, mainly because operators were not in a position to measure and record the required information. Furthermore, much of the data were of questionable value as they were readily susceptible to coloring by the opinion of the individual making the report.

Instrumentation, with the resulting records of performance of various papermaking arrangements and processes, has given the designer new engineering tools with which to work. The scientifically accurate devices which make it possible to determine and control papermaking variables, such as freeness, consistency, pH, moisture, and caliper, have been generally accepted by the industry and are, in many instances, considered standard equipment on new machines.

The modern paper machine, whether it be of the latest design and construction, or an older type, rebuilt and modernized, must in either circumstance be able to produce a constantly uniform product to conform with the rigid requirements and specifications encountered in the present paper market. Since the basic principles of papermaking, from formation to finishing, are subject to countless variables, it is essential to satisfactory operation that the controllable variables adversely affecting the finished product be subjected to proper controls. Much has been accomplished to control the variables in the preparation of stock and delivery of same to the machine, but beyond this point, little has been done.

J. C. HARPER and T. A. McARN, Downingtown Mfg. Co., Downingtown, Pa.

Let us assume that the stock preparation is under reasonably efficient control and is being delivered to the forming section under uniform conditions. Let us further assume that the formation is as satisfactory as can be expected in view of the capabilities of the forming section.

At this point, the sheet enters the press section, which from an investment and operational viewpoint, is one of the most expensive and important sections of the entire paper machine. It is here that the process of water removal begins, and to a great extent, the final quality of the paper is determined. Regardless of the huge investment cost and importance of the press section, however, it is frequently one of the most neglected.

For each ton of paper produced, the cost to remove water in the press section of a paper machine is only a fraction of the cost to remove a similar amount in the drier section. Therefore, from the standpoint of economy, it is essential that the presses are operated in such a manner that the maximum amount of free water is removed before the sheet passes on to the driers. It is also obvious that the water must be removed uniformly across the sheet if the desired results are to be obtained. To accomplish this, the loadings on each press roll across the nip must be carefully and accurately controlled.

It has been customary to assume that, on a press equipped with dead-weight loading, if the weights are equally spaced on the lever arms, a uniform nip pressure will result. Due to variables which cannot be controlled, this assumption is not always the case. In some instances, with weights on the front and rear of the press in exactly the same positions, a loading difference of more than a ton between front and rear sides has been detected. Similar variations in loading have been observed on presses equipped with hydraulic or pneumatic cylinders or springs.

It has been determined by investigation that ideal conditions seldom exist in practice. The press rolls may be accurately ground to the proper crown, but if in the weighting system there is a dirty, worn, or cocked knife edge, a stuck fulcrum pin, or a defective gage, it becomes impossible for the operator to be certain that the press is properly loaded.

Many "difficult to control" factors inherent to any paper machine, such as slice adjustment, uneven stock flow, changing felt structure, and the like, may influence loading. Compensation for these variable influences on press loading, when left entirely to the judgment of the operator, may well result in adjustments which not only fail to correct nonuniform loading but may even compound the error.

In an effort to solve the problem of nonuniform roll

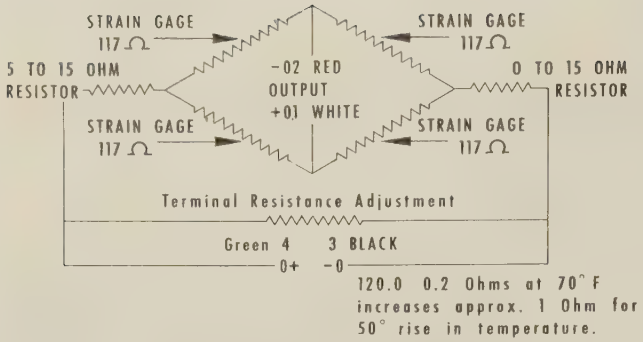


Fig. 1. Basic strain gage

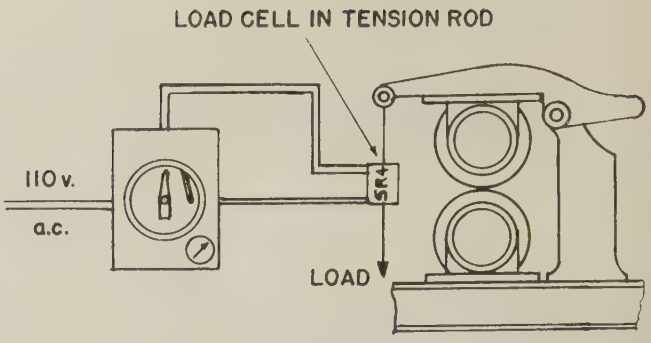


Fig. 3. Diagram showing method of press loading

loading, which apparently exists in most machines, an extensive research program was conducted into various systems for measuring roll loads. In order to properly evaluate and compare these loading systems, the following features were considered to be essential requirements: (1) rugged construction resistant to operational damage; (2) minimum number, or absence, of moving parts; (3) calibration not affected or changed by use; (4) resistance to temperature, humidity, or barometric changes; (5) simplicity of construction and installation; (6) previous proved use in comparable industrial applications; and (7) measuring device does not affect the quantity being measured.

Many systems of measurement and control were studied, both within and without the paper industry, and after exhaustive experiments the load meter was selected as being the only system which met all of the above requirements and which was the most accurate method for determining, recording, and controlling press roll loading.

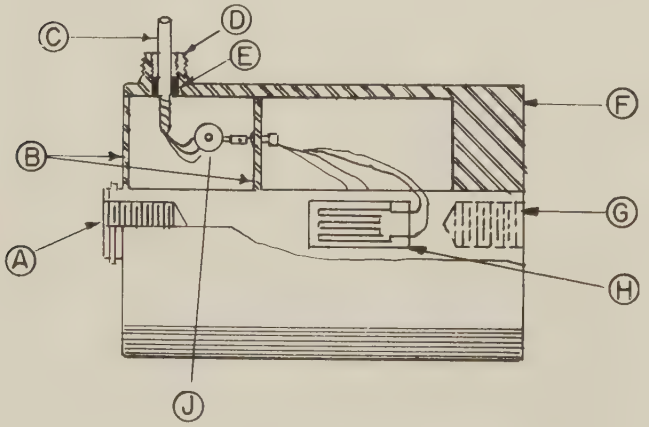
The fundamental principle which forms the basis of the load meter is the strain-resistance relationship of metal wires discovered by Kelvin. In the SR-4 bonded wire strain gage, we have a valuable element which when built into a unit forms a device for measurement which does not affect the measurement. Further, in the development of this device employing the strain gage, we have a rugged force measuring system which has no moving parts to wear, does not change calibration with constant use or with normal atmospheric changes, is simple and inexpensive to install, and is inherently accurate enough to encourage its use as a weighting system in many industrial applications. Figure 1 illustrates graphically the theory from which the load meter is developed.

The unit (Fig. 2) consists, essentially, of short lengths of strain-sensitive wires bonded intimately to a high quality tool steel bar or load-carrying column. This bar is interposed directly into the load-carrying member of the press. Any slight change in the load on this column causes the strain gages to undergo resistance changes precisely proportional to the applied strain. Since the wires of the strain gages carry an electric current, change in resistance results in a change in output voltage. This voltage change, calibrated in units of weight or force, can be measured on an indicator or recorder of the potentiometer type. It may also be used to actuate a control mechanism

Figure 3 is a diagram showing a typical load meter arrangement on a conventional press. The same principal applies to mechanical, pneumatic, or hydraulic loading. Figure 4 illustrates pneumatic loading with load cell mounted in the press base frame. Figure 5 illustrates pneumatic loading with load cell under compression in the press top arm.

The load to be measured may be carried by a single cell or distributed over several cells, as may be required. In the latter case, the response of the whole group of cells may be automatically totalized to give a single reading.

Since the external circuits involved are entirely electrical, the indicators, recorders, or controllers may be located at any desired point, near to or remote from the cell itself. Also, since the cell is hermetically sealed, and external circuits can be carried in sealed conduits, the system is protected against the moisture conditions prevalent in paper mills. The protective shell is of



A. Four notches for locking threaed end fitting with pin.
B. Diaphragms hermetically sealed.
C. Ten-foot neoprene-covered shielded cable.
D. One-half inch—14NP thread for conduit.
E. Cable seal.
F. Base can be drilled and tapped for locking threaded end fitting.
G. Female threaded ends, both ends.
H. Special Bakelite type SR4 strain gages on load sensitive column.
J. Calibration and terminal adjustment resistors.

Fig. 2. Sketch U-1 load cell

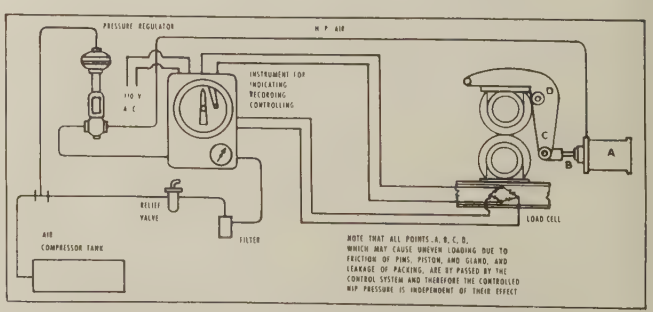


Fig. 4. Diagram showing pneumatic loading in base frame

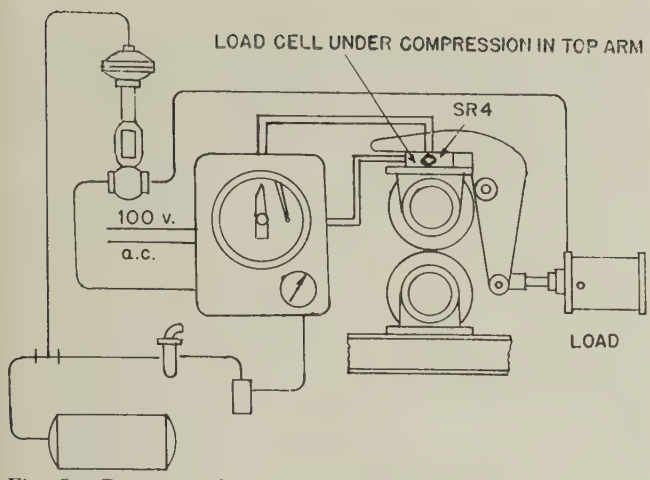


Fig. 5. Diagram showing pneumatic loading in top arm

heavy seamless steel tubing with a single sealed cable opening. The four-wire shielded armored cable can be furnished in any reasonable continuous length and the load cell can be calibrated to compensate for the desired cable length.

The advantage of being able to locate the load meter directly at the load point, and the instrument at a remote protected location has great appeal to those mills that are safety conscious. The load cell requires an electrical input of about 120 ohms at only 4 to 8 v., which small current is no hazard to operating personnel.

Figure 6 is a close-up view of the air cylinder mechanism on a press roll. Figure 7 is a similar installation on a suction press. Figure 8 shows wall-mounted circular chart indicating and recording instruments. Figure 9 shows a similar strip chart instrument installation.

The load cell equipment used in the load meter system is calibrated to be accurate within $\pm 0.25\%$, and the over-all system is guaranteed to be accurate within 1%. Such accuracy compares favorably with precision instruments and is not generally expected in a rugged device such as the load meter.

Having outlined the basis for selection of the load meter as the most satisfactory means to measure and control press loading, the inherent deficiencies of other load measuring instruments, which eliminated them from consideration, should be mentioned.

Air or hydraulic loading systems, with loading indicated by Bourdon tube-type gages, are subject to considerable inaccuracy. The vital measuring element of the instrument is usually exposed to the fluid, the pressure of which is being measured. The fluid may cause serious corrosion of the measuring element, it may solidify, and it may be subject to violent pulsations in fluid pressure which can completely destroy the accuracy of the instrument, as well as greatly shorten its life owing to wear of the mechanical linkage of fatigue failure of the elastic member.

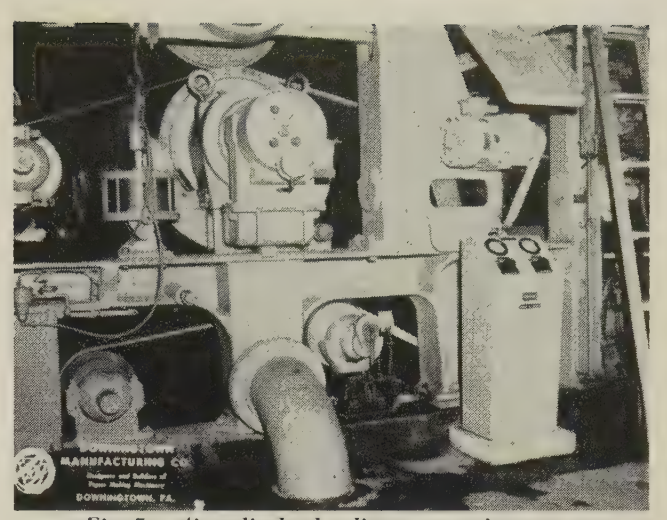


Fig. 7. Air cylinder loading on suction press

Metal diaphragm types of gages are not generally satisfactory as pressure gage elements. The diaphragm must be large in order to produce a satisfactory deflection under pressure, and this limits its application to relatively low pressures. The dial scale must be hand calibrated to account for peculiarities of each diaphgram. A slight overload is apt to cause a permanent set, and the elastic modulus is subject to temperature changes.

The liquid filled load cell employs a hollow cell filled with liquid from which a tube is connected to the instrument. When loaded the compression of the cell is transmitted through the tube by displacement of the liquid. In this system, the distance from the load point to the instrument is limited. The accuracy is affected by temperature changes due to contraction or expansion of the liquid. The tube is vulnerable to accidental stoppage or distortion by external damage.

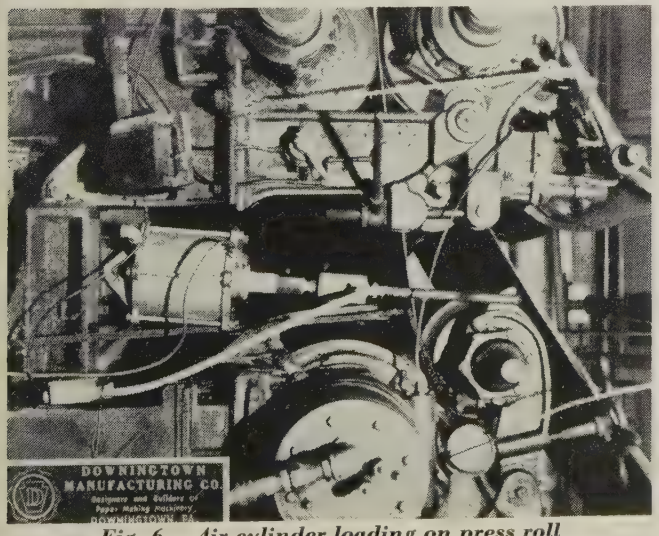


Fig. 6. Air cylinder loading on press roll

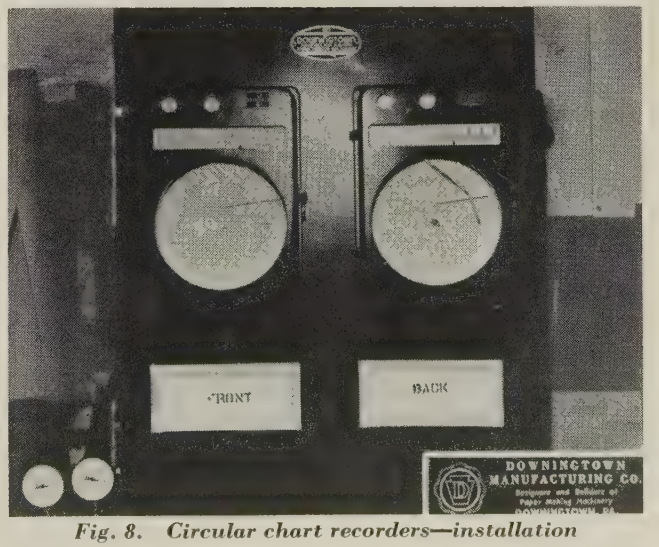


Fig. 8. Circular chart recorders—installation

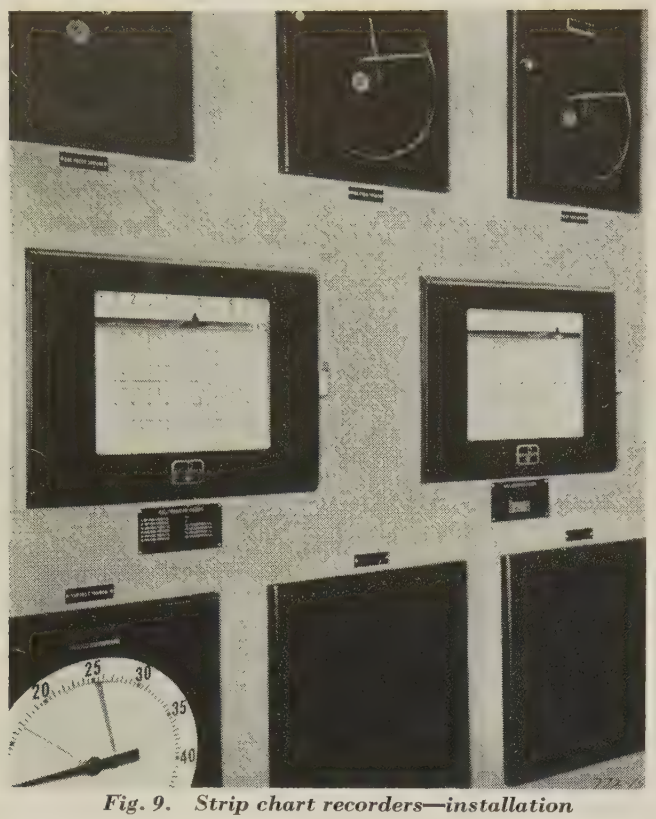


Fig. 9. Strip chart recorders—installation

Ordinary gages are not constructed to be built in as part of the machine and are not sufficiently strong in themselves to carry heavy loads. Not being built in as part of the structure, they are subject to undesirable external influences.

After the strain gage load meter had been selected as the only instrument completely conforming to the seven basic requirements previously mentioned, actual mill installations revealed additional favorable characteristics which are not common to other gages. Sudden changes in load, such as breaks in the paper web, or lumps passing between the rolls, are readily picked up by the load meter. Ordinary gages of the types described will not respond quickly enough to detect these momentary loads.

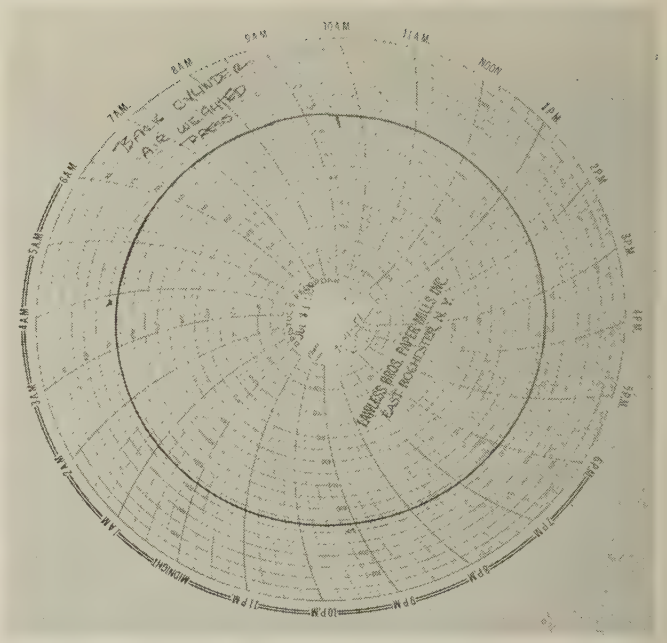


Fig. 11. Circular chart—rear end loading

Defects in the loading system such as stoppages or breaks in the air or oil lines are not always detected by ordinary gages. Such gages have been known to stick before such a break occurred and thus gave a false indication. The load meter, not being subject to such a condition, gave the operator the signal that something was amiss with the loading system and the damaged connection was discovered.

When properly installed, the load meter will indicate such unsuspected loads as fulcrum point and pin friction, packing and gland friction of loading cylinders, eccentric and out-of-round conditions of rolls and journals, thrust of gearing and pull of drive chains, belts, and the like.

Figure 10 shows a chart record of loading over a 24-hr. period on the front end of an air-weighted press. Figure 11 shows a similar record of the rear end of the same press. Figure 12 shows a 24-hr. record of the load pressures on both front and rear ends of a press recorded

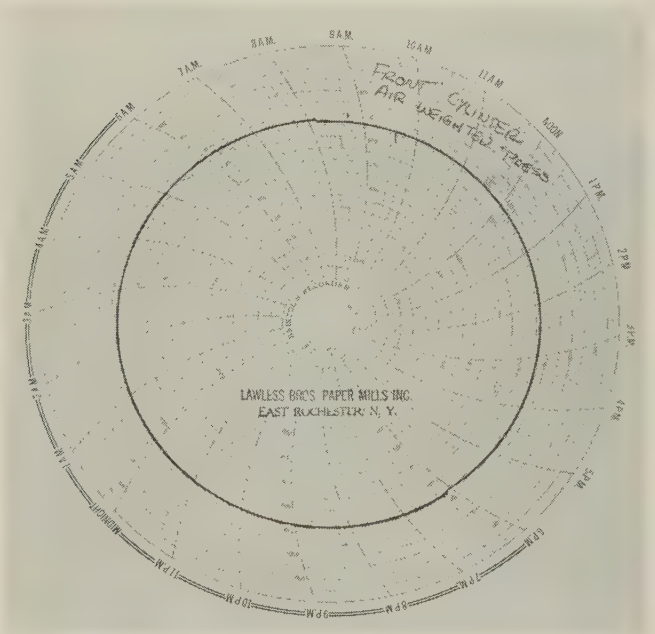


Fig. 10. Circular chart—front end loading on press

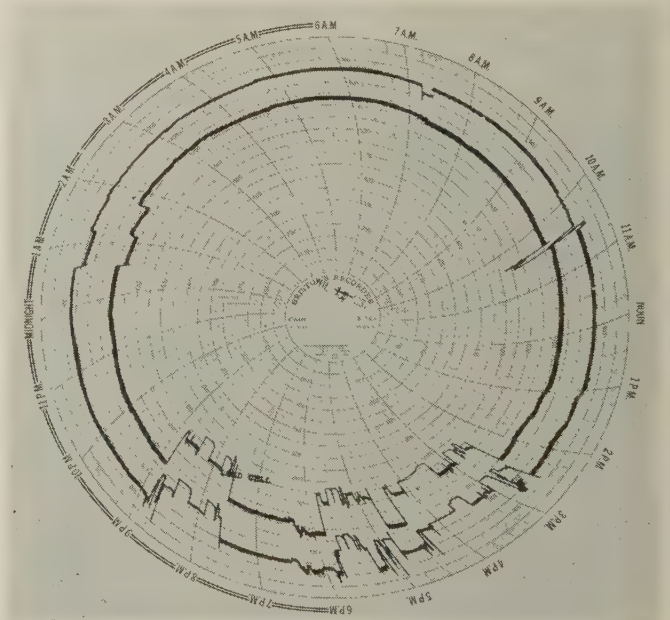


Fig. 12. Circular chart—front and rear loading

Fig. 13. Press section—installation

on a single instrument, calibrated so that there is no overlapping of lines.

Some of the economic advantages to be derived from the installation of load meters have already been suggested in the foregoing description. Reports from mills having load meter installations confirm the following operational cost and quality benefits:

Felts. Press felt life, and hence felt cost per ton, is

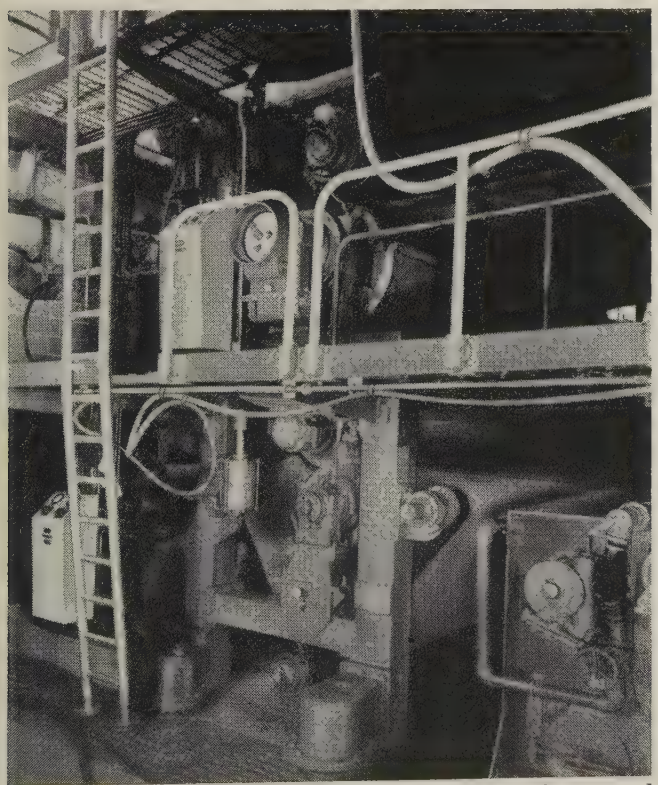


Fig. 14. Press section—installation suction drum and extractor

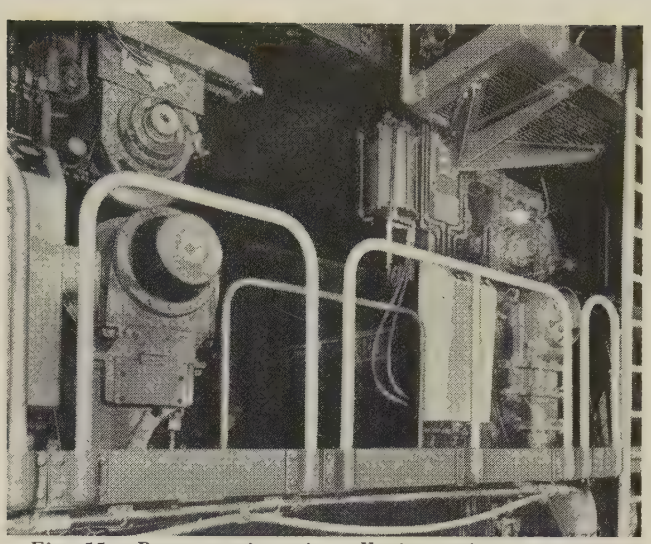


Fig. 15. Press section—installation primary presses

to a large extent determined by the frictional wear imposed on the felt as it passes around the rolls. Nonuniform pressure across the nip of the press rolls sets up heavy undesirable stresses within the fibers of the felt and will appreciably shorten felt life. The load meter provides means for uniform loading and hence prolongs felt life.

Drying. The over-all drying rate of a paper machine is limited by the length of time required to dry the wettest part of the sheet as it enters the drier section. If a sheet leaving the last press contains excessive moisture in streaks due to nonuniform pressing, the sheet must remain on the driers for a sufficient length of time to dry these streaks, with consequent overdrying of the rest of the sheet. By employing the load meter to accurately controlled maximum correct nip pressure at all times, streaks due to nonuniform pressing are eliminated, production will be increased, and hence drying costs reduced.

Trim. Overdried or underdried edges resulting from nonuniform roll pressures can be a source of considerable tonnage loss because of excessive trim and substandard sheet sizes. Uniform press loading and control will help to insure that the maximum possible trim width is obtained.

Quality. Uniform press loading and control will improve the uniformity of caliper, tensile strength, density, and finish and hence assist the operators to produce a higher quality sheet.

Records. Proper indication, recording, and control-

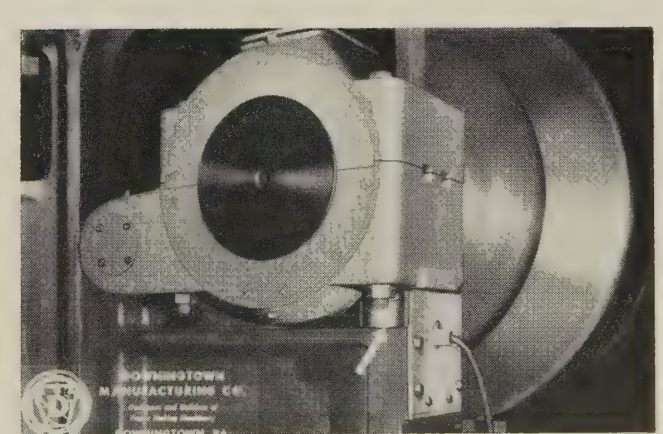


Fig. 16. Pivoted bottom press roll bearing—installation

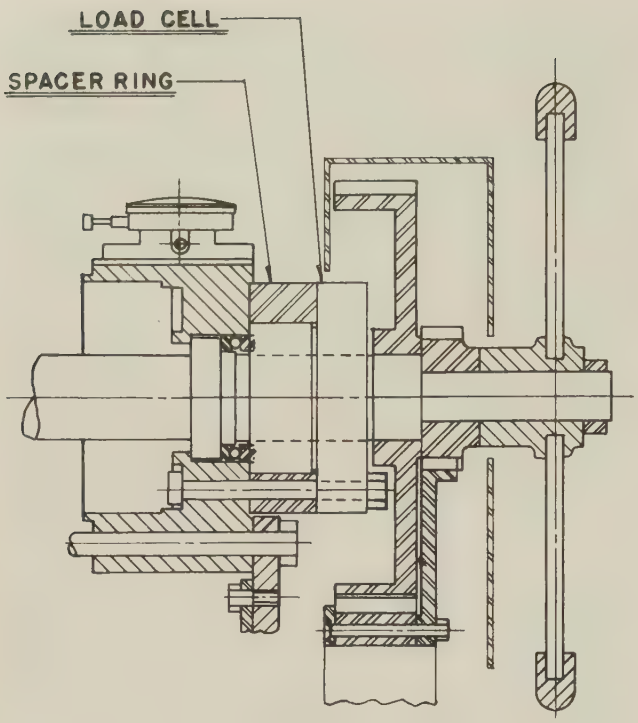


Fig. 17. Refiner load cell

ling will enable the operators to establish the correct loading for each grade of paper made. The recording figures, when used to repeat a run of paper under any set of operating conditions and furnish, will help to reproduce a sheet of specified caliper, density, and finish.

Fringe Benefits. In the case of unusual machine characteristics, where it may become desirable to purposely maintain nonuniform pressures in order to overcome faulty machine adjustments, the exact pressure differential for correction can be determined and maintained until the fault is located and corrected. In a recent installation of a load meter on a first press, the rear side consistently showed a load 400 lb. greater than the front side, with air cylinder pressures being equal. The difference was eventually traced to the effect of the top roll drive. But for the load meter warning, this condition would have been unnoticed, or ascribed to some other cause.

Figure 13 shows an installation of load meters at various points of the press section of a board machine. Figure 14 gives a closer view of the same press section showing two load cells in each of the suction drum press top arms, and a single cell in each of the suction extractor air cylinder piston rods.

Figure 15 gives a closer view of the two load cells incorporated in the top arms of each primary press. Identical load cells are located above the rear bearings. This machine is equipped with a total of 26 load meter

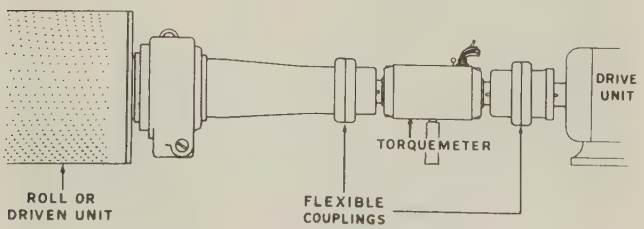


Fig. 18. Torquemeter

Fig. 19. Torquemeter—chart—7-15-53

cells. Figure 16 illustrates a convenient and compact installation of the load meter employing a pivoted bottom press roll bearing. After the weight of the bottom roll is zeroed out, the load cell measures the exact amount of weight being applied to the sheet.

The load meter is a versatile instrument which can be installed with advantage on a number of other machines used in the paper industry. It has applications for pressure control in calenders, beaters, and refiners and is used to measure or control wire and felt tension.

An installation has recently been made on a refiner to record the thrust load. Exact figures are not yet available for the record, but preliminary reports indicate that the thrust loads are considerably greater than previous calculations would indicate. It is expected that this experimental installation will provide a new source of reliable and accurate operating data hitherto unavailable. Figure 17 shows the manner in which the

Fig. 20. Torquemeter—chart—7-9-53

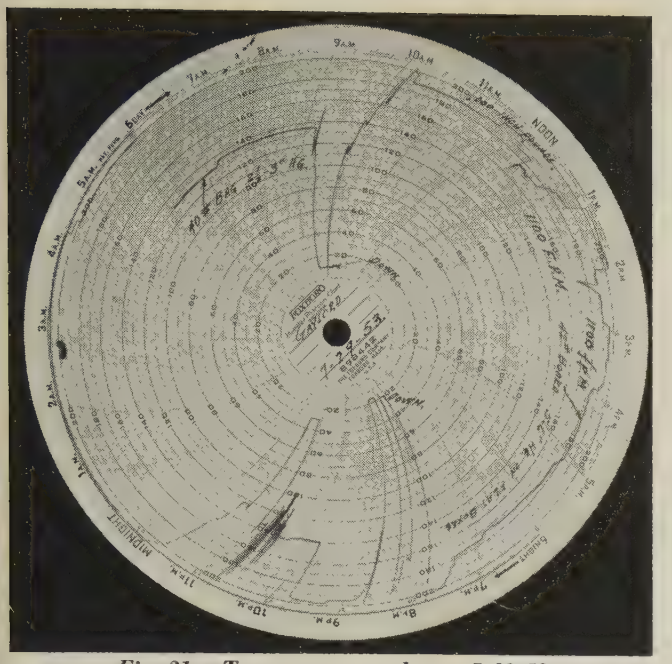


Fig. 21. Torquemeter—chart—7-29-53

"doughnut" shaped load cell, especially developed for this application, was installed.

To those who are concerned primarily with the operation of fourdrinier machines, the most recent development and application of the strain gage principle embodied in the torquemeter, will be of interest. This device has been successfully applied to the couch roll drive shaft of a large high-speed fourdrinier machine with spectacular results. Figure 18 is a diagram sketch illustrating the torquemeter application to a couch roll drive shaft.

The torquemeter consists of a torque pickup and a recording instrument. The torque pickup is essentially a short length of shaft which, when loaded in torsion, translates that torsion into changes in electrical energy. Thus, when coupled into a shaft, the pickup will measure the torque being transmitted by that shaft while in no way influencing or changing its magnitude.

Fig. 22. Torquemeter—chart—wire break

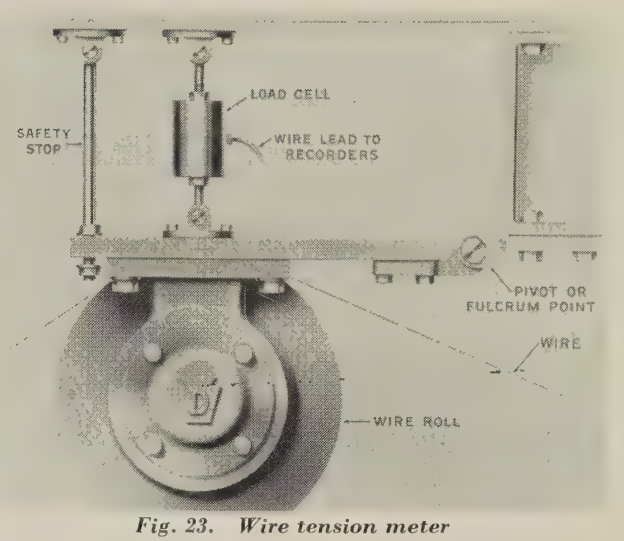


Fig. 23. Wire tension meter

The pickup sensitive element is a modification of the SR-4 bonded resistance wire gage in which any change in strain produces a corresponding change in resistance of the wire. The wire gages are bonded to the shaft in such a position and are so connected into a bridge circuit as to cancel the effects of bending and thrust strains while adding the effects of torsional strains. The relation between bridge unbalance and torsional strain is exactly linear.

Slip rings on the shaft and a nonrotating brush assembly allow the strain gage bridge to be energized and its unbalance measured by a recording instrument. The instrument and connections thereto are similar to those used in conjunction with the load meter, except that the instrument is calibrated in inch-pounds torque.

The chart readings obtained from the torquemeter installed on the couch roll drive shaft of a kraft fourdrinier machine provide the operators with immediate and continuous information with regard to the operating status of the fourdrinier.

Figure 19 is a reproduction of a chart showing uniform operation on 35-lb. bag paper at 1250 f.p.m. Since the torquemeter will furnish a reading which will give the exact tension in the wire, any variations of speed, stock freeness or consistency, sheet weight, or vacuum on the suction boxes can be detected immediately. Figure 20 is a chart which clearly illustrates the comparison between satisfactory and unsatisfactory operation as recorded by the torquemeter. Figure 21 is another chart showing records obtained when changing grades. The operators quickly learn to depend upon the torquemeter for information which was unavailable to them previously, or at best, only after sheet tests have been made.

In one instance a wire was torn off the machine due to excessively high suction box drag. This wire could have been saved if the operator had been alert, since the torquemeter record showed that the horsepower input to the drive shaft was in excess of the maximum permissible (Fig. 22).

Operating records obtained to date indicate that it is possible to operate a fourdrinier with considerably less vacuum than was formerly believed necessary, and that possibly some suction boxes could be dispensed with.

To summarize the advantage of an actual torquemeter installation on a fourdrinier machine, the follow-

ing statements have been submitted by the mill management:

1. Our installation is on the drive shaft on the wire couch of a turbine-driven machine. With torque, revolutions per minute, horsepower relationship we are now able to determine the horsepower required to drive the wire couch at different load conditions; i.e., on different speeds, grades of paper, etc. This valuable information was not previously available to us.
2. With a means of determining the horsepower to drive the couch, we have observed the relationship between degree of refining, amount of water in the sheet, vacuum carried on flat boxes, etc., to the load to drive wire couch, on any particular grade.
3. We have also noted changes in load to drive couch due to the effects of foam in the wire pit or soft stock, etc. These changes occur without changing running conditions and it is to our interest to study and reduce these influencing factors to keep load on wire couch down. A measure of torque and horsepower is essential to this problem.
4. We can now observe the effect of changes in equipment on load to drive wire couch.
5. We can prolong wire life by using the torquemeter as a guide to run with minimum load on the wire.
6. Maintenance cost of our torquemeter, which has been in operation for approximately 9 months, has been small.

Wire tension on fourdrinier machines is the resultant of two variables: (1) the force exerted by the stretcher roll against the wire, and (2) tension created by friction of the suction boxes, table rolls, etc.

We have already discussed the manner of determining and controlling wire tension caused by friction by means of the torquemeter. The first mentioned source of nonuniform or excessive wire tension can be accurately measured and controlled by the tension meter shown in Fig. 23.

The tension meter consists of two load cells located between the bearings of an idler wire roll and the frame or sole plates. Front and rear wire tension is recorded on a single instrument. This equipment provides a simple, accurate, and dependable source of information to enable the machine tender to control the wire tension correctly.

A similar application of the load meter, which will undoubtedly become more popular as the mills learn of the availability, is to measure and control felt tension. It is generally conceded that excessive felt tension contributes substantially to decreased felt life. By incorporating a small load meter system in the felt stretching mechanism it becomes entirely practical to determine the desirable tension under which a felt will provide the greatest service, and then by suitable control means, be certain that the felt tension is maintained accordingly.

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Experiments with Digester Corrosion Variables

E. W. HOPPER and J. B. MORRISON

The subject matter included in this paper may be divided into three distinct classifications. First, a study covering the variables in chemical analyses and physical characteristics of a large group of carbon steel samples taken from plates which have gone into kraft digester service. Second, a study of the corrosion effect of variables in white liquor compositions on different types of steel under varying conditions. Third, an attempt to determine the effect on corrosion rates of protective films build-up on the steel by cathodic protection. The results indicate that these are factors which may be contributory to the increasing rate of attack and are worthy of continued investigation.

If it were possible to determine how and why corrosion takes place on carbon steel in a kraft digester, we should be able to take the proper steps to correct the conditions or at least to reduce the rate of attack. Some theories have been advanced to account for the accelerated corrosion rates. These do not appear to fit all cases where rapid thinning of the steel takes place.

Is it possible to determine why excessive attack develops through careful inspection, thickness readings, and statistical studies? Or, can it be done through laboratory research alone? Probably the best approach is through a combination of both coordinating the laboratory and research data obtained with that obtained by field inspection. Certainly all factors which can be contributory should be carefully studied for their effect. The authors have found that each step leads to additional possible factors. Some of these can best be studied by those well versed in the complex chemistry involved in the kraft cooking operations.

The authors do not present the data included in this paper or the conclusions drawn, as complete and positive. More work will be required and is under way to clear up some of the inconsistencies in the data and add to the general knowledge on the study.

CARBON STEEL INVESTIGATION

Since our last report, 56 additional steel samples taken from digester plates have been secured and examined chemically, spectroscopically, and by etch testing. The results show the very great variation in the chemistry of the steel, its method of manufacture, cleanliness, porosity, number and type of inclusions. If complete service records can be secured for this group of steels, together with adequate chemistries of the cooking liquors used, a good indication may be reached on the effect of steel manufacture on the rate of corrosive attack.

Wherever etch tests showed a distinct rim on the steel samples, separate test pieces and drillings were taken and run to determine the difference in chemistry between the core and rim. These results show the greater relative purity of the rim as compared with the core. They also show one of the reasons why variations can be shown in the steel chemistry, depending on where the drill samples are taken for analysis. The results of the chemical and spectroscopic tests are shown in Table I.

E. W. Hopper and J. B. Morrison, Crucible Steel Co. of America, Pittsburgh, Pa.

Table I. Carbon Steel Digester Plates

No.	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Al	Sn	Pb
1	0.09	0.42	0.010	0.023	0.008	0.21	0.06	0.04	0.02	None	0.030	None
2	0.21	0.42	0.012	0.034	0.001	0.31	0.07	0.06	0.02	None	0.030	None
3	0.13	0.36	0.010	0.028	0.003	0.19	0.08	0.03	0.03	0.018	0.010	None
4C	0.20	0.46	0.012	0.035	0.010	0.17	0.09	0.07	0.04	0.010	0.050	None
4R	0.10	0.41	0.010	0.020	0.005	0.14	0.07	0.06	0.04	0.010	0.020	None
5	0.21	0.46	0.012	0.023	0.050	0.10	0.03	0.02	0.02	None	0.010	None
6	0.10	0.38	0.010	0.022	0.003	0.28	0.08	0.04	0.03	None	0.010	None
7	0.18	0.40	0.012	0.039	0.002	0.21	0.09	0.04	0.03	0.060	0.030	0.001
8	0.14	0.36	0.013	0.036	0.003	0.17	0.06	0.04	0.02	0.040	0.010	0.001
9	0.10	0.32	0.010	0.036	0.001	0.35	0.10	0.05	0.04	0.170	0.040	0.010
10	0.11	0.37	0.012	0.028	0.001	0.18	0.08	0.03	0.03	0.030	0.020	None
11	0.09	0.36	0.010	0.036	0.001	0.25	0.09	0.08	0.04	0.006	0.030	None
12	0.16	0.44	0.013	0.037	0.001	0.21	0.09	0.06	0.02	0.050	0.030	0.001
13C	0.18	0.41	0.012	0.036	0.010	0.19	0.10	0.05	0.03	0.020	0.020	None
13R	0.08	0.37	0.012	0.021	0.005	0.18	0.09	0.05	0.03	0.010	0.020	None
14	0.13	0.43	0.010	0.028	0.003	0.20	0.06	0.03	0.03	None	0.010	None
15	0.13	0.37	0.010	0.036	0.001	0.38	0.11	0.05	0.03	0.040	0.040	0.001
16	0.18	0.44	0.011	0.040	0.003	0.21	0.08	0.04	0.02	0.040	0.020	0.001
17	0.11	0.40	0.013	0.031	0.001	0.17	0.05	0.06	0.02	None	0.020	None
18C	0.19	0.40	0.012	0.040	0.010	0.30	0.21	0.09	0.04	0.020	0.070	None
18R	0.09	0.34	0.010	0.020	0.005	0.27	0.16	0.08	0.04	0.010	0.030	None
19	0.11	0.37	0.011	0.030	0.001	0.19	0.07	0.05	0.04	None	0.020	None
20	0.15	0.37	0.005	0.036	0.010	0.20	0.07	0.04	0.02	0.033	0.030	None
21C	0.16	0.37	0.005	0.030	0.010	0.19	0.08	0.04	0.02	0.020	0.020	None
21R	0.08	0.43	0.012	0.025	0.010	0.16	0.07	0.04	0.02	0.007	0.010	None
22	0.16	0.37	0.007	0.035	0.010	0.20	0.08	0.04	0.02	0.025	0.020	None
23	0.11	0.37	0.007	0.023	0.010	0.14	0.06	0.04	0.03	0.005	0.020	None
24	0.06	0.31	0.009	0.019	0.010	0.18	0.05	0.05	0.04	0.004	0.030	None
25	0.13	0.35	0.015	0.037	0.010	0.34	0.13	0.10	0.03	0.016	0.050	None
26	0.19	0.32	0.007	0.038	0.010	0.14	0.06	0.04	0.02	0.030	0.020	None
27C	0.14	0.37	0.007	0.037	0.010	0.15	0.05	0.04	0.02	0.015	0.010	None
27R	0.07	0.38	0.012	0.024	0.010	0.14	0.05	0.04	0.02	0.030	0.010	None
28C	0.14	0.36	0.017	0.038	0.010	0.36	0.12	0.11	0.04	0.020	0.060	None
28R	0.07	0.40	0.013	0.023	0.010	0.30	0.12	0.09	0.03	0.007	0.020	None
29	0.06	0.34	0.007	0.018	0.010	0.21	0.09	0.05	0.04	0.004	0.020	None
30C	0.09	0.39	0.006	0.022	0.010	0.23	0.06	0.06	0.04	0.002	0.100	None
30R	0.06	0.40	0.012	0.020	0.010	0.21	0.07	0.05	0.05	0.005	0.100	None
31C	0.15	0.36	0.010	0.033	0.010	0.27	0.12	0.07	0.03	0.020	0.060	None
31R	0.09	0.38	0.013	0.024	0.010	0.25	0.12	0.06	0.04	0.090	0.050	None
32C	0.17	0.42	0.015	0.039	0.010	0.44	0.11	0.07	0.03	0.015	0.050	None
32R	0.08	0.42	0.013	0.024	0.010	0.31	0.10	0.06	0.04	0.005	0.050	None
33C	0.20	0.37	0.009	0.035	0.010	0.15	0.05	0.04	0.02	0.001	0.020	None
33R	0.09	0.32	0.012	0.025	0.010	0.15	0.03	0.06	0.02	Nil	0.020	None
34C	0.17	0.40	0.012	0.035	0.010	0.20	0.06	0.04	0.02	0.001	0.020	None
34R	0.09	0.40	0.012	0.025	0.010	0.18	0.05	0.05	0.02	Nil	0.020	None
35	0.14	0.33	0.006	0.032	0.010	0.15	0.04	0.03	0.02	0.001	0.020	None
36	0.15	0.38	0.010	0.034	0.010	0.20	0.06	0.05	0.02	0.004	0.020	None
37	0.14	0.46	0.017	0.035	0.010	0.32	0.09	0.07	0.02	0.006	0.040	None
38C	0.14	0.40	0.008	0.034	0.010	0.28	0.08	0.04	0.02	0.003	0.050	None
38R	0.08	0.50	0.011	0.022	0.010	0.26	0.05	0.06	0.03	Nil	0.040	None
39	0.14	0.44	0.017	0.035	0.020	0.28	0.11	0.10	0.03	Nil	0.040	None
40	0.07	0.37	0.006	0.021	0.010	0.14	0.05	0.04	0.03	0.001	0.020	None
41C	0.17	0.71	0.012	0.068	0.010	0.19	0.06	0.04	0.02	Nil	0.060	None
41R	0.07	0.37	0.011	0.021	0.010	0.17	0.03	0.04	0.02	Nil	0.040	None
42	0.11	0.38	0.007	0.032	0.010	0.22	0.08	0.08	0.04	Nil	0.030	None
43	0.12	0.48	0.010	0.032	0.010	0.19	0.08	0.06	0.04	Nil	0.030	None
44	0.09	0.44	0.006	0.021	0.010	0.16	0.06	0.04	0.03	Nil	0.020	None
45C	0.12	0.37	0.013	0.035	0.010	0.27	0.08	0.05	0.02	0.004	0.050	None
45R	0.07	0.35	0.012	0.023	0.010	0.27	0.07	0.06	0.02	Nil	0.030	None
46	0.14	0.40	0.013	0.031	0.010	0.28	0.11	0.08	0.02	0.004	0.030	None
47	0.08	0.40	0.009	0.012	0.010	0.16	0.06	0.04	0.02	0.001	0.020	None
48C	0.10	0.42	0.007	0.028	0.010	0.23	0.08	0.07	0.04	Nil	0.030	None
48R	0.07	0.37	0.010	0.022	0.010	0.22	0.07	0.08	0.03	Nil	0.030	None
49C	0.18	0.58	0.015	0.056	0.010	0.25	0.09	0.08	0.03	Nil	0.050	None
49R	0.07	0.35	0.011	0.022	0.010	0.21	0.05	0.07	0.03	Nil	0.030	None
50	0.13	0.34	0.007	0.020	0.010	0.22	0.06	0.05	0.02	Nil	0.030	None
51	0.17	0.44	0.013	0.026	0.060	0.02	0.04	0.04	0.02	0.001	0.010	None
52	0.17	0.39	0.018	0.022	0.050	0.03	0.03	0.03	0.02	Nil	0.020	None
53	0.14	0.39	0.007	0.035	0.010	0.17	0.04	0.04	0.02	Nil	0.020	None
54	0.14	0.52	0.009	0.030	0.010	0.20	0.08	0.05	0.02	0.001	0.020	None
55	0.15	0.72	0.014	0.022	0.100	0.03	0.07	0.06	0.03	Nil	0.010	None
56C	0.12	0.51	0.015	0.035	0.010	0.30	0.06	0.06	0.04	Nil	0.040	None
56R	0.10	0.45	0.014	0.020	0.010	0.35	0.07	0.07	0.04	Nil	0.040	None

W, V, Ti, Cb, and B—Checked spectroscopically, none.
C—Core material; R—Rim material.

The etch tests also show the marked difference in the physical structure of the steel samples. Some of these show distinct thin or thick rims, others, little or no rim. Some of the steels are very dense in character, others range from fairly dense and clean to those with numerous large inclusions, porosity, and general dirtiness. Many of the etch test results can readily be associated with the steel chemistry and permit classification of the steels as rimmed or killed steels. Figures 1 and 2 picture steel samples no. 1 to 19, inclusive, after etch testing.

Sample 55 was trepanned from a digester in service which did not respond to Audigage testing over that portion of the respective plate. Supersonic testing

Table II

Bath no.→	1	2	3	4	5
NaOH (in terms Na_2O), g.p.l.	74.6	73.8	76.6	70.8	65.3
Na_2S (in terms Na_2O), g.pl.	13.8	13.8	14.4	13.2	24.6
Na_2CO_3 (in terms Na_2O), g.p.l.	16.3	15.8	14.9	13.2	14.4
Na_2SO_4 (in terms Na_2O), g.p.l.	2.3	2.3	0.16	0.38	3.87
NaCl (in terms Na_2O), g.p.l.	0.38	5.5	0.13	0.02	0.66
Active alkali (in terms Na_2O), g.p.l.	88.4	87.6	91.0	84.0	89.9
Sulphidity, %	15.6	15.7	15.8	15.7	27.4
Causticity, %	82.1	82.4	83.7	84.3	81.9
Na_2SO_4 (as such), g.p.l.	5.21	5.31	0.36	0.87	8.87
NaCl (as such), g.p.l.	0.71	10.42	0.24	0.03	1.24

Bath no. 1: Regular sulphate sulphidity—by reduction of salt cake. For this sample we added sodium hydroxide to suphlate white liquor (76–53) in order to reduce the sulphidity to the 14 to 18% range, and then diluted with water until the liquor contained about 90 g.p.l. active Na_2O.
Bath no. 2: 10 grams per liter of NaCl added to sample no. 1.
Bath no. 3: Sulphidity obtained by refinery waste. Refinery waste (41–53) added to a solution of sodium hydroxide and sodium carbonate to obtain a sulphidity of 14 to 18%.
Bath no. 4: Elemental sulphur was dissolved in a solution of sodium hydroxide and sodium carbonate, by heating in the laboratory digester for 4 hr. at 170°C. This converts polysulphide to sulphide and thiosulphate.
Bath no. 5: Sulphate white liquor (76–53), as received.

verified the fact that this steel sample did not react in the usual manner. The laboratory reported that the steel seemed to be "mushy." The etch test, shown in Fig. 3, did not show any laminations in the steel as was anticipated. There was no rim noticeable in the etch test. The structure was porous with many large inclusions present. An inclusion count was run and showed large oxide and silicate inclusions. Undoubtedly, the large inclusions, up to a 9 size, caused the sonic testing device to react as it did.

EFFECT OF STEEL AND WHITE LIQUOR ON CORROSION RATES

In order to check on the effect of the chemistry of the steel and white liquor on corrosion rates, five lots of white liquor were made up, analyzed, and supplied to us by the research department of one of the paper companies. The analyses of these liquors as reported, and the notes covering the method of make-up are shown in Table II.

For steel testing, specimens of steel approximately 1.5 by 1.0 by 0.25 in. were cut from a silicon killed steel and from the core and rim of a rimmed steel with a thick rim. The silicon killed steel was from plate furnished to the A-212 specification. The respective test specimens were machined from single plate coupons and given a uniformly high surface polish by laboratory metallographic polishing technique. The dimensions were carefully measured and the areas calculated for each series of test runs. The chemistry of the steel samples used in all the following tests is shown in Table III.

In this series of tests, the core and rim specimens, carefully cleaned chemically and weighed, were introduced together into the white liquor baths, freshly heated to 205 to 210°F. The baths were approximately 225 ml. each and contained in stainless steel beakers.

Table IV

Bath no.	Core	Rim	Killed
1	0.0989	0.1062	0.0876–0.0853
2	0.1112	0.1043	0.1008–0.0913
3	2.2630	2.2170	1.6944–1.6510
4	0.2010	0.1743	0.1946–0.2110
5	0.8450	0.8375	0.7525–0.7985
5 Duplicate	0.8910	0.8825	0.7999–0.7525

The test specimens were kept apart so that galvanic contact was not present from sample to sample. The same test specimens were used in each bath with careful polishing, measuring, cleaning, and weighing before each corrosion test. Tests were run for 1 hr. as it was felt that this short period would tend to give the best indication of steel and bath corrosive effects.

Tests on the killed steel were run in a similar manner, using duplicate specimens of killed steel so that conditions would be as nearly uniform and comparable as possible.

After the 1-hr. test, the steel samples were removed from the bath, washed with water, and the surface film removed by a slight scrubbing with a mild abrasive cleaning powder and dilute pickle. The carefully dried test pieces were then reweighed and the weight losses calculated to inches penetration per year. These results are shown in Table IV.

GALVANIC COUPLE EFFECT—RIM TO CORE

Due to the marked difference in chemistry between the rim and core of rimmed steels, it was felt that tests should be run to detect possible potential differences between the samples immersed in the white liquor baths and the effect on the corrosion rates. The same test specimens were used in each of these tests so that the conditions would be uniform from bath to bath and comparable to the previous series of tests.

The test specimens were prepared in the manner described earlier, fitted in a fixture, and hooked together through a galvanometer. Tests were run for 1 hr., with potential readings taken at 1-min. intervals. A second series was then run for 5 hr. to determine whether the corrosion would continue at a constant rate or tend to increase or decrease.

The potential readings did not show a distinct trend either way and the tables of readings are not included in this paper. In most cases, the potential difference varied slightly from one side of the circuit to the other so that the rim might be cathodic and then anodic. In a few cases, there was a noticeable initial potential difference of as much as 100 m.v. which quickly dropped to approximately 0 m.v. or varied between + or −5 m.v. either way.

The weight losses in all cases were carefully determined and again calculated to inches penetration per year. The results are shown in Table V.

EFFECT OF AERATION OF BATHS ON RATE OF ATTACK

It was noticed in one case, that the corrosion rate on

Table III

Type or section	C	Mn	P	S	Si	Cu	Ni	Cr	Mo
A-212	0.25	0.76	0.017	0.026	0.23	0.05	0.06	0.02	0.01
Core	0.08	0.37	0.022	0.064	0.01	...	0.17	0.01	0.01
Rim	0.04	0.32	0.010	0.024	0.01	...	0.13	0.03	0.01

Table V

	Bath 1		Bath 2		Bath 3		Bath 4		Bath 5	
	Core	Rim	Core	Rim	Core	Rim	Core	Rim	Core	Rim
1 hr.	0.2364	0.2028	0.2364	0.2136	2.6280	2.5920	0.2856	0.3468	0.1848	0.1936
5 hr.	0.1362	0.1921	0.1272	0.1956	0.5100	0.4524	0.2736	0.2244	0.5736	0.5256

test samples run in bath 3 which has been boiled for 5 min. before immersing the specimens, was much lower than that run on the same bath just brought up to temperature. In order to determine whether this might be due to driving air out of the bath, tests were run to determine the effect of aeration of the bath on corrosion rates. In this series of tests, the test pieces were mounted in the baths so that in one case a fine jet of air impinged on the test piece, whereas the other piece was opposite it and subjected only to the aerated bath condition. For uniformity, these tests were run on the killed steel test specimens. The weight losses obtained were calculated to inches penetration per year and are shown in Table VI, together with the comparable results on the nonaerated baths taken from Table IV.

Table VI

Bath no.	Air jet impinging on surface	Aerated	Nonaerated
1	0.1308	0.1128	0.0876–0.0853
2	0.1404	0.1248	0.1008–0.0913
3	2.9064–2.6560	1.5696–1.9560	1.6944–1.6510
4	0.2664	0.2388	0.1946–0.2110
5	1.4904–2.2200[a]	1.1808–1.1630[a]	0.7525–0.7985

[a] Tests rerun at a later date and discussed further on.

Slight pits in the steel surface were noted where the fine air jet was directed against the surface of the steel. Above this pit, a slight grove in the surface of the steel was apparent, denoting the path of the air bubbles up the surface.

One test was run in bath 1 with air jet impinging on a specimen for 24 hr., resulting in a corrosion rate of 0.6120 i.p.y. along with a pit 0.0025 in. deep.

TESTS WITH STEAM IMPINGEMENT

Two test runs were made using steam in place of air impingement in bath 3. The tests were run in a comparable manner to those described using aeration. One test specimen had the steam jet striking the surface of the killed steel specimen. The other was in an opposite position and subject to the corrosive effect of the steam agitated bath. Tests were for 1 and 2 hr. duration. The results, calculated to inches penetration per year are shown in Table VII. There was a noticeable difference in the effect of the steam jet versus the air jet at the point of contact with the steel. Whereas, the air caused a pit to form, the steam jet protected the steel and at that point there was a very slight knob apparently unattacked.

EFFECT OF NITROGEN REPLACING AIR ON RATE OF ATTACK

In order to determine whether oxygen was responsible for the increased corrosion rates noted with aeration, a similar limited series of tests was run using nitrogen in place of air. There was a hold-up in piping up the nitrogen and several months elapsed between this series and the previous run with aeration. These tests have been run only on baths 3 and 5.

The penetration rates on bath 3 were very low compared with those obtained with the aerated as well as with the nonaerated bath 3 tests. The specimen on which the nitrogen jet impinged had a lower rate than the second test specimen which was subject only to the nitrogen agitated bath. This was contrary to the experience noted with the air jet impinging on the surface.

Table VII

	Steam jet impinging on surface	Steam agitated
1 hr.	0.7020	1.3432
2 hr.	0.5600	1.6667

The penetration rates on bath 5, however, were much higher with nitrogen than with air. Again, the nitrogen flushed specimen had a lower rate than the second test piece subject to the nitrogen agitated bath.

The point where the nitrogen impinged on the steel surface was unattacked in all cases although there was noticeable attack directly surrounding the area. This corresponded with the results with steam and was opposed to those found with air impingement.

The results of the tests with nitrogen are shown in Table VIII.

RECHECK ON AERATION TESTS

In order to recheck the corrosion rates and determine whether there was a difference in the corrosiveness of the baths, some rechecks were made.

These showed that on bath 3, the corrosion rate on the nonaerated bath shown in Table IV to average 1.6727, had increased to 2.3288 i.p.y. Unfortunately, this took up the last of white liquor 3.

The rerun on bath 5 showed the corrosion rate increased from the average shown in Table IV of 0.7759 to 1.3085 i.p.y. A rerun with aeration showed an increase from 1.4904 to 2.2200 i.p.y. on the impingement test specimen but a slight decrease from 1.1808 to 1.1630 i.p.y. on the second test piece in the bath. These tests took up the remainder of white liquor 5.

THE EFFECT OF FIR SAWDUST ON THE CORROSION RATE OF WHITE LIQUOR

This series of tests was run with fir sawdust added to the white liquor, using the killed steel test pieces. In this case 200 ml. of white liquor plus 25 grams of fir sawdust was used, giving a bath just about filled with sawdust. The tests were run for 1 hr. and the results calculated to inches penetration per year. Table IX shows the results compared with similar results without the addition.

Table VIII

Bath no.	Nitrogen jet impinging on surface	Nitrogen agitated
3	0.4560	0.5490
5	1.505–1.522	2.199 -2.319–2.245

Table IX

	Bath 1	Bath 2	Bath 3	Bath 4	Bath 5
Bath and sawdust	0.0294	0.0261	0.8398	0.0636	0.2138
Bath alone	0.0876	0.1008	1.6944	0.1946	0.7999
	0.0853	0.0913	1.6510	0.2110	0.7525

CATHODIC PROTECTION AND CORROSION RATES

A series of tests were made to observe the effect of a cathodically formed film on the corrosion rate of carbon steel. Samples of stainless steel and A-212 carbon steel coupons were prepared and introduced into a white liquor bath at the same time. The pieces were connected externally to a carefully controlled and regulated e.m.f., with the stainless steel being the anode and the carbon steel the cathode. The applied potential was varied from test to test for a fixed period of 1 hr. to observe the effect on corrosion rate at various potential levels.

Table X shows the corrosion rates at the various applied e.m.f. values.

Slight gassing was observed at the carbon steel electrode (cathode) at the 1.00-v. level.

THE EFFECT AND LIFE OF CATHODICALLY FORMED SURFACE FILM

A second series of tests were made to determine the possible life and characteristics of the cathodically formed film. The test procedure as previously described, was repeated for the 1-hr. period. At this point the stainless steel anode was quickly removed and a piece of polished and lightly pickled carbon steel substituted in its place. This time the electrodes were connected externally through a carefully balanced potentiometer to observe and record the potential differences between the electrodes at various time intervals. The initial voltage drop varied depending on the previous cathodic treatment. The filmed electrode was cathodic to the unfilmed.

The formation of the cathodic film and the subsequent film life when connected galvanically to an unfilmed piece, depended on the previous applied voltage treatment.

Figure 4 shows the potential differences that existed at various time intervals following different previous cathodic treatments.

For purposes of comparison, curve I is a typical plot of the potential drop when the filmed sample is obtained without benefit of an externally applied potential. The initial voltage drop was 0.290 v. and fell rapidly to 0.005 v. within 12 min. The filmed electrode was cathodic and the unfilmed anodic.

Curve II was obtained when the previously applied voltage was 0.10 v. for 1 hr. The initial voltage drop was 0.282 and decreased rapidly to 0.205 v. within 1 min. At this point an increase occurred reaching a maximum of 0.220 v. at the 5-min. point. A gradual downward trend started at this time and, after 25 min., fell rapidly to approximately 0.010 v. After 40 min. the voltage drop had reached zero. Again the filmed electrode was cathodic.

Curve III was obtained when the previously applied potential was 0.20 v. for 1 hr. The initial potential was 0.207 and again fell rapidly to 0.155 after 2 min. At this point an increase occurred leveling off at 0.230 at the 15-min. period. The potential remained at this level until a gradual decrease started at the 80-min. point. After 180 min., the voltage drop had decreased to 0.005 v. The filmed electrode was again cathodic.

Curve IV shows the time-voltage curve after an applied voltage of 0.50 v. for 1 hr. The initial voltage drop was 0.210 and decreased rapidly to 0.140 v. within 1 min. This was followed by a gradual increase reaching a maximum of 0.230 at approximately 50 min. At this point a gradual decrease began and assumed the pattern of curve III. The filmed electrode, as before, was cathodic and the unfilmed the anodic.

Curve V is a result of a previously applied voltage of 1.0 v. for 1 hr. The initial voltage drop was 0.278 and decreased rapidly to 0.218 v. after 2 min. At this point it leveled off and remained relatively constant until a gradual decrease began after 100 min. At 210 min. the potential had dropped to 0.003 v. The filmed electrode was cathodic and the unfilmed anodic.

The procedure was repeated with an applied cathodic potential of 2.0 v. for 1 hr. The results are shown by curve VI. The initial voltage was low compared with all previous tests, being 0.05 v. There was an immediate decrease to 0.01 after 3 min. followed by a very rapid rise in voltage to 0.125 at 5 min. This was followed by an equally rapid decrease to zero at 11 min. At this point a reverse in polarity occurred with the previously filmed electrode becoming anodic and the clean piece cathodic. After 40 min. of reversed polarity, which had reached a voltage drop of 0.0075 v., a zero potential was again reached. Thereafter polarity fluctuated with readings of +0.003 to −0.003 v.

Corrosion rates were calculated on both the previously filmed electrode and the clean or unfilmed piece from both the 1.0 and the 2.0-v. tests. These rates were calculated to include the time in bath for the filming operation.

Table XI shows the corrosion rates of each electrode under the designated bath conditions.

Table X

Applied e.m.f., v.	Weight loss, grams	Inches penetration per year
0.20	0.0029	0.1222
0.40	0.0030	0.1236
0.50	0.0032	0.1344
0.75	0.0034	0.1392
1.00	0.0009	0.0329

SUMMARY

The carbon steel test coupons submitted for test illustrate the very marked differences in the type of steel being supplied for kraft digester service. Samples range from 0.06% carbon to a high of 0.21%, manganese from 0.31 to 0.72%, phosphorus from 0.005 to 0.018%, sulphur from 0.012 to 0.068%, silicon from 0.001 to 0.060%, aluminum from nil to 0.170%, copper

Table XI

Test series	Electrode	Time in bath, min.	Weight loss, grams	Penetration, i.p.y.
1.0 v.—1 hr.	Filmed	275	0.0187	0.1484
	Unfilmed	215	0.0668	0.7280
2.0 v.—1 hr.	Filmed	120	0.0125	0.2412
	Unfilmed	60	0.0173	0.7164

from 0.02 to 0.44%, nickel from 0.03 to 0.21%, chromium from 0.02 to 0.11%, and tin from 0.01 to 0.100%. In one case 0.010% lead was also found.

The etch tests showed the steel to vary from those with no rim to those with a distinct, thick rim. Some were obviously killed steels and showed a dense, clean structure. Others illustrate very well the variables in rimmed steel, that is, in cleanliness, density, porosity, and inclusions from steel heat to heat as well as from rim to core.

If we are able to secure thickness readings and operating details on the digesters from which these steel coupons were secured, it should be possible to evaluate accurately the effect of variables in steel chemistry and physical structure on digester life.

The variables in steel chemistry and the method of manufacture did not show marked differences in the test results obtained in the laboratory study. The corrosion rates on the chemically purer and denser rim steel were generally lower than those on the core. However, the differences in penetration rate in all the tests run were insignificant as compared with the results expected, particularly when the test specimens were connected to form a galvanic cell. Contrary to the results of the statistical study, the silicon killed A-212 steel test results were appreciably lower than those obtained on the rim or core of the rimmed steels.

There are several variables which might affect the rate of digester attack which cannot be evaluated here. One of these is the adherence of the protective film to the steel surface. There did seem to be a greater tendency for this film to hold more tightly to the less dense core test pieces than to the more dense rim and killed specimens. A second but opposite effect would be that of the relative hardness of the steel and its abrasion resistance.

The laboratory test results do show very definitely the marked effect on corrosion rates of differences in the chemistry and make-up of the white liquor. These penetration rates vary by a ratio greater than 20 to 1. The results are quite consistent in the rates of attack on the three lots of steel test specimens for each bath.

The authors feel that these results are significant. They show conclusively the vast variation in the corrosiveness of white liquors.

A comparison of the penetration rates with the white liquor analyses shown in Table II, does not show any one chemical constituent definitely causing an increase or decrease in corrosiveness. For instance, bath 3 is highest in NaOH content and highest in corrosion rate. Bath 5 is lowest in NaOH content and is the second most corrosive white liquor tested. Bath 4, lowest in NaOH caused a penetration rate roughly twice as great as bath 1 with higher NaOH.

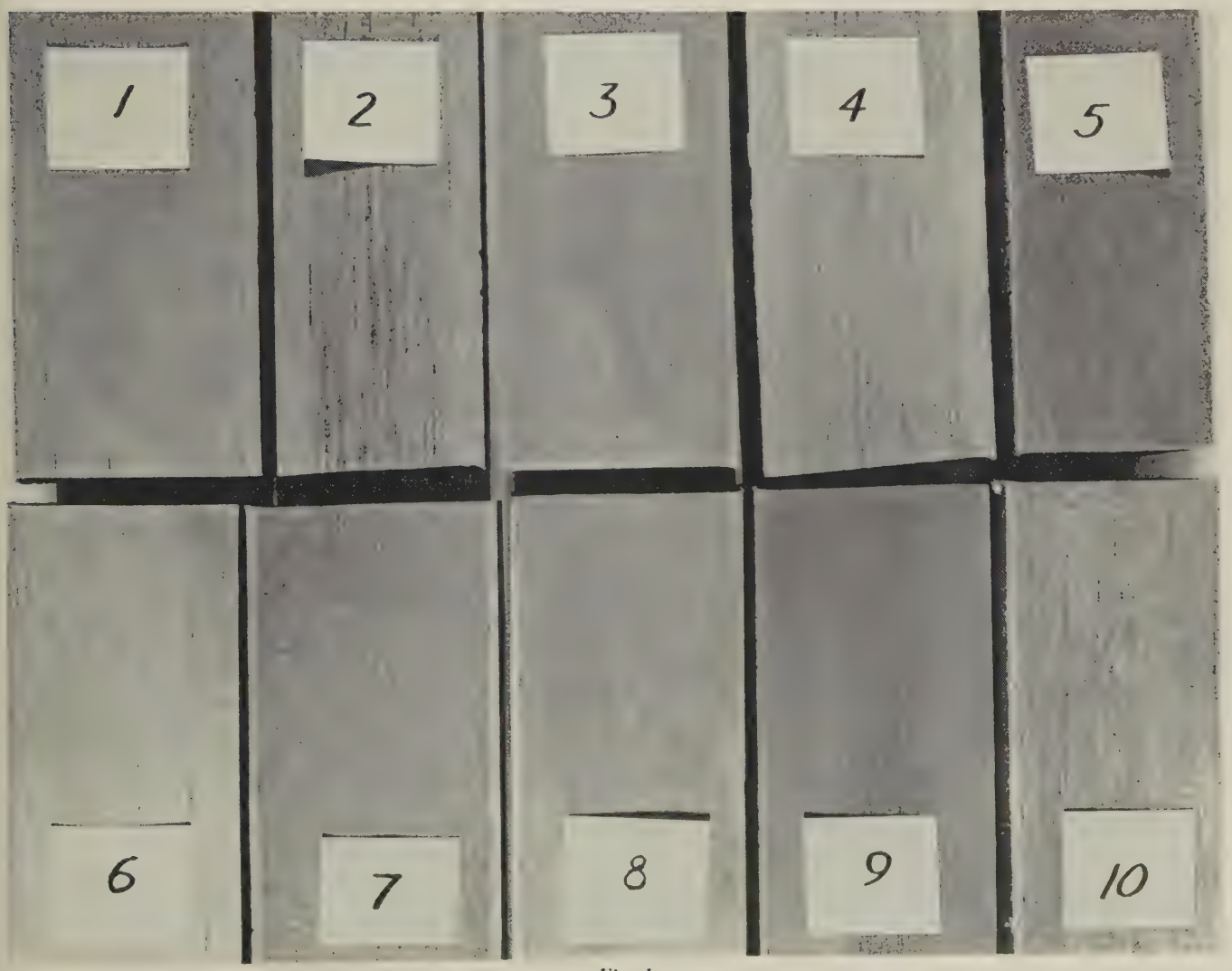

Fig. 1

The Na_2S content does not appear to be the dominant factor in increasing the rate of attack. The greatest corrosion was found in bath 3 with a lower Na_2S content than bath 5 which had the highest Na_2S concentration. However, the make-up of bath 1 does indicate that the Na_2S content may be a factor. Bath 1 was made by diluting bath 5 with water to reduce the Na_2S concentration to approximately the same value as the other four baths. Sodium hydroxide was then added to bring that chemical constituent to the equal of the other baths. This procedure reduced the corrosiveness to about one eighth of the original bath.

An increase in the Na_2CO_3 content does not tend to increase the rate of attack as based on our laboratory results. The lowest corrosion was found in baths 1 and 2 with the highest carbonate content.

A high Na_2SO_4 concentration does not appear to increase the corrosiveness of the bath. Baths 1 and 2 are relatively high in sulphate and lowest in penetration rate. Bath 3 is lowest in sulphate and highest in rate of attack. On the other hand, bath 5 is highest in sulphate and second highest in corrosiveness.

Bath 2 was made up by adding sodium chloride to bath 1. This apparently resulted in a very slight increase in corrosiveness. However, bath 3 with low chloride content has the highest rate of attack.

The results of these tests tend to indicate that there are other factors in the chemistry of the white liquors which have a much greater effect on the rate of attack on carbon steel than those chemicals reported, which are based on the normal chemical analysis. There must be a definite reason for the corrosiveness exhibited by bath 3. This type of bath in service also showed excessive attack on the digester steel. Is the difference in the degree of attack due to complex sulphides not differentiated by normal chemical analyses?

The penetration rates shown in Table V show some interesting trends when compared with those reported in Table IV. The difference in the method of testing lies in the coupling of the rim and core test pieces together in the bath to form a galvanic cell. The penetration rates for the 1-hr. run have increased over those not coupled together, except in the case of bath 5, which showed the lowest penetration. Bath 3 was again the most corrosive but percentagewise, it had not increased in the same proportion as baths 1, 2, and 4.

The 5-hr. tests were run in a similar manner to determine whether the rates of attack shown in the 1-hr. test would continue at a uniform rate, increase or decrease. The rates in baths 1, 2, and 4 show a reduction, but indicate that corrosion is still progressing. The penetration in bath 3 has dropped so that it appeared that all attack stopped during the first hour of immersion. In the case of bath 5, the rate increased greatly after the first hour, if the results of the 1 and 5-hr. tests are accurate.

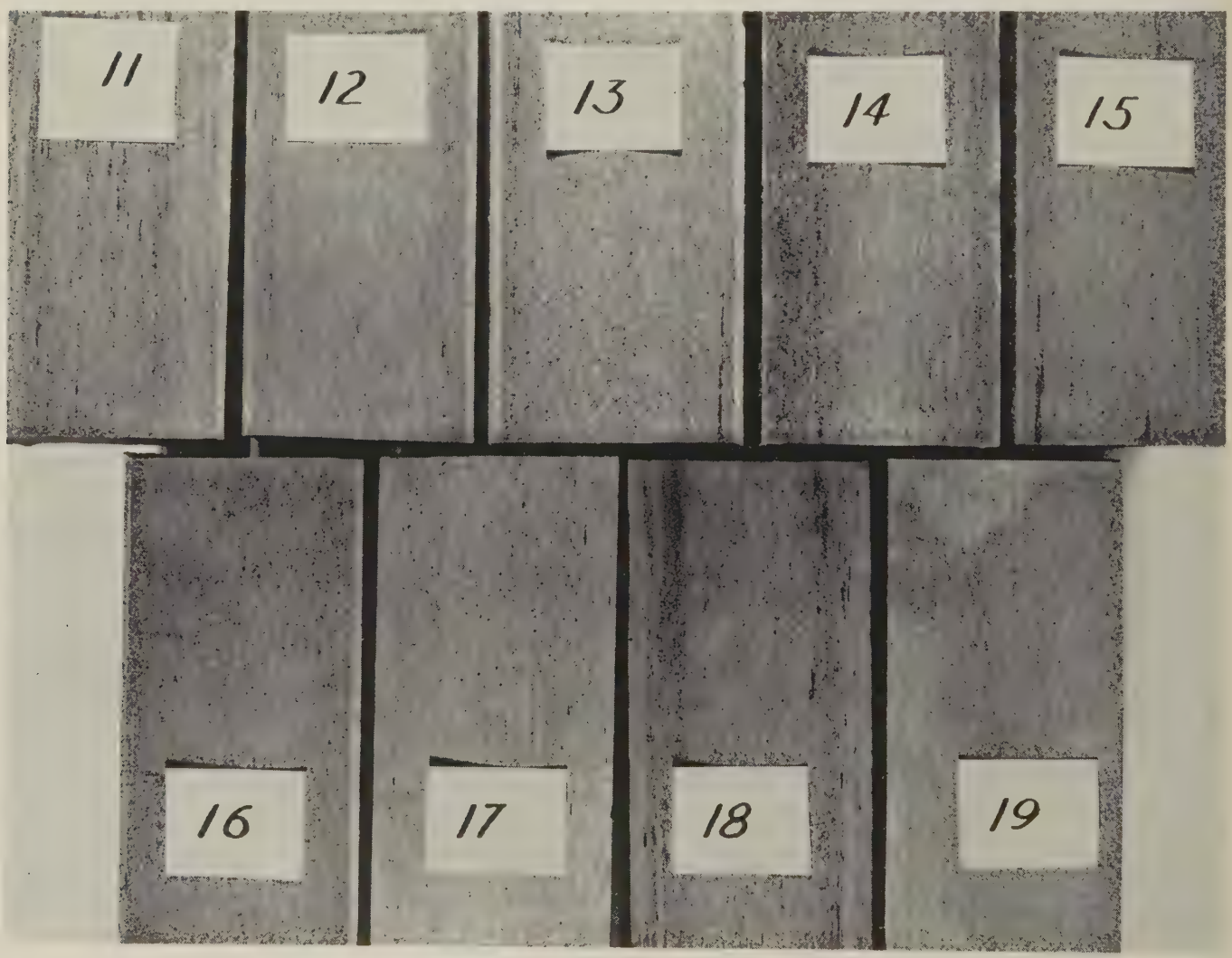

Fig. 2

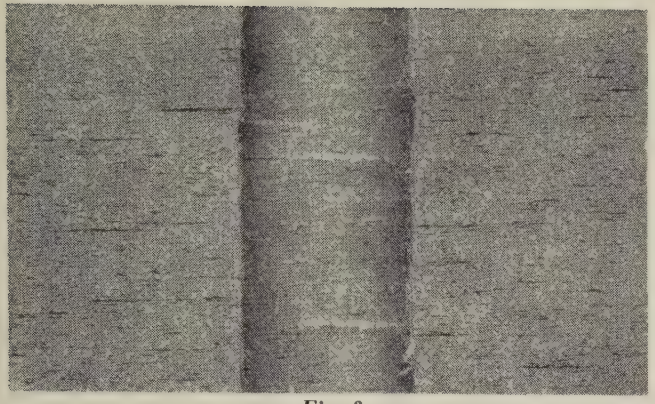

Fig. 3

In a single run on bath 3, otherwise comparable to the 1-hr. galvanic couple test, the bath was boiled vigorously for 5 min. before the test pieces were immersed. The corrosion rates in this test showed a tremendous reduction over the unboiled test. Whereas the rim had previously shown 2.6280 in. penetration, the rate after boiling dropped to 0.0246 in. In comparable manner the core rate dropped from 2.5920 to 0.0193 in. This reduction of +99% in corrosiveness has not been checked further. It is on the schedule for rerun. If the results prove to be accurate, the reduction in corrosiveness may be due to reduced oxygen content in the bath or a change in the chemistry of the bath.

In order to check on the effect of oxygen or air, the series of tests with the results shown in Table VI were run. In order to assure steel uniformity, these tests were run using killed steel test specimens. Aeration of the baths increased the rate of attack except for bath 3, which showed a decrease but on re-run, an increased rate. The greatest increase was noted in bath 5.

In those cases where the air jet impinged directly on the steel surface, the rate of attack was higher, particularly in the case of baths 3 and 5. At the point where the fine air jet was directed at the steel, a noticeable pit developed. Above this pit, where the air bubbles rose along the steel surface, a slight but noticeable groove was etched into the steel. A 24-hr. test in bath 1, the least corrosive, with an air jet directed against the killed steel test piece, showed a rate of 0.6120 i.p.y. versus 0.1308 in. on the 1-hr. test. In addition, a pit to a depth of 0.0025 in. was measured microscopically at the point where the air jet impinged on the steel.

An attempt was made to determine whether the increased attack noted with aeration could be due to agitation of the bath by the air jet. Therefore, a similar test was run on bath 3 using a steam jet directed against one of the killed steel test pieces. These runs were for 1 and 2 hr. duration. The penetration rates on the steam jet flushed specimens are much lower than those struck by the air jet, and in fact, lower than in the nonaerated tests. Instead of the pit at point of impingement, the steam seems to have washed away or diluted the bath at that point so that little or no corrosion developed, leaving a slightly raised knob effect. The corrosion rate on the other test pieces immersed in the steam-agitated bath showed corrosion rates about comparable to those in the air-agitated test.

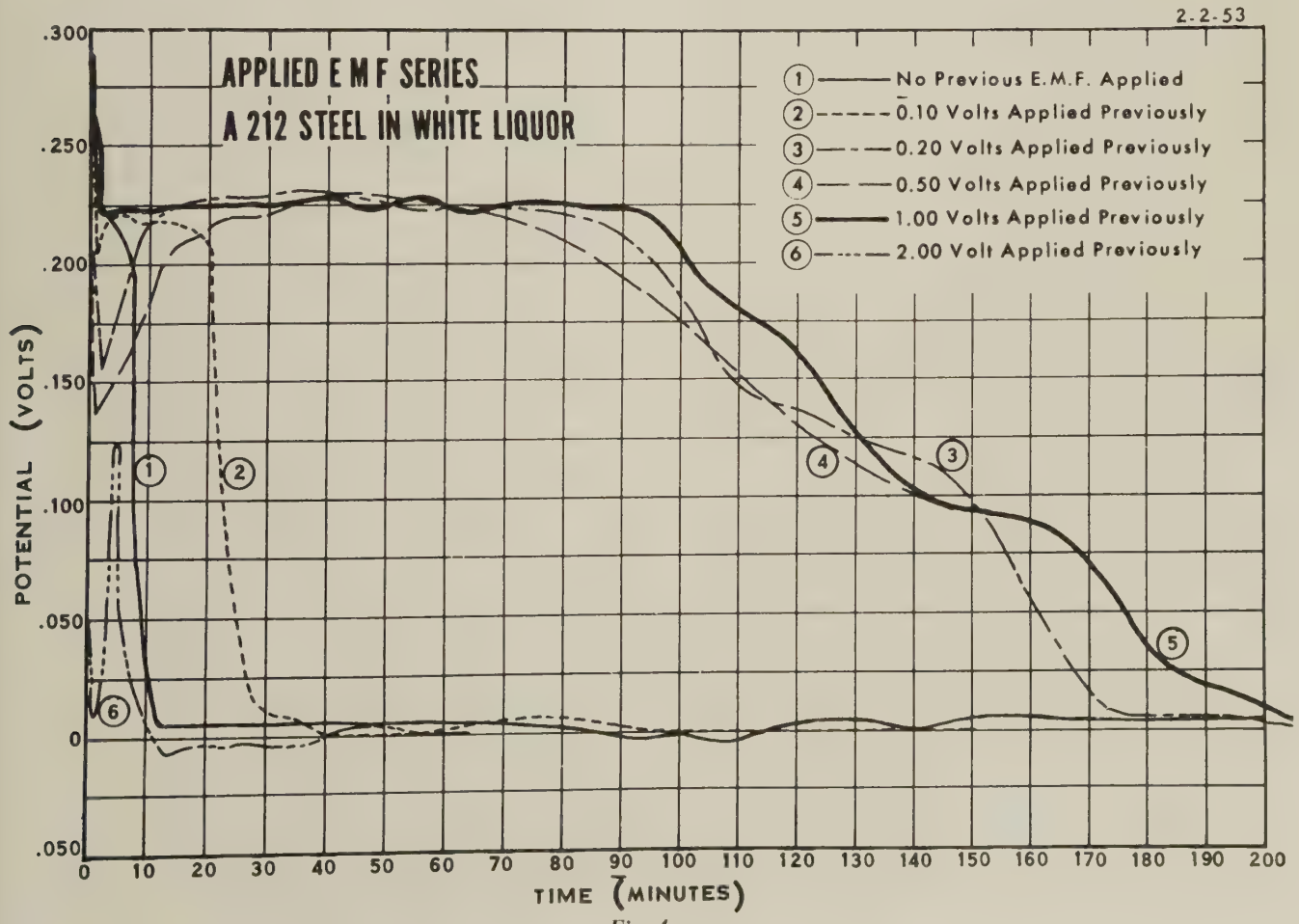

Fig. 4.

A further limited series of tests was run on baths 3 and 5 using nitrogen in place of air impingement and agitation. The results shown in Table VIII are contradictory when compared with the results using air shown in Table VI. In bath 3 the rate of attack has been greatly reduced below the comparable rates with air. The test piece with the nitrogen jet directed at the surface is lower than the one not struck by the jet. There is also a slight knob at the point of impingement apparently where the nitrogen bubbles swept the liquor bath from the steel surface. On the other hand, the test results on bath 5 showed a marked increase in rate compared with those run with air. However, the test piece on which the nitrogen jet impinged again showed a lower corrosion rate and a raised knob at point of impingement. These test results were duplicated and show excellent check results.

In order to check on the baths to determine if there was a change in corrosiveness on standing for several months, tests were run on baths 3 and 5, comparable to those reported in Table IV. This showed that the corrosiveness had increased on the nonaerated bath 3 from an average of 1.6727 to 2.3288 in. and, on bath 5 from an average rate of 0.7759 i.p.y. to 1.3085 in. A test with aeration showed the rate with air impingement to have increased from 1.4904 to 2.2200 in. although the other test piece not struck directly by the air had a rate about comparable to the original run.

The tests with air, steam, and nitrogen seem to indicate that the aeration and air impingement cause an increase in corrosion rate; steam decreases the degree of attack; and nitrogen may also decrease the corrosiveness. It is possible that baths 3 and 5 behave differently with respect to oxidizing and nonoxidizing conditions.

Both of these baths, however, appear to have become more corrosive to carbon steel after standing for several months, tightly sealed but, after having been opened and sampled repeatedly. This certainly raises another variable in testing.

There has been some discussion on the effect of cooking different woods on the corrosiveness of cooking liquors. The comments have been that the hardwoods increased, whereas pine decreased the rate of attack. The test results shown in Table IX indicate a reduction in the penetration rate with fir sawdust present ranging from about 50% in bath 3 to close to 75% in bath 2.

The tests run with cathodic protection applied to the carbon steel unfortunately do not have a blank run under similar conditions but without applied current. It is realized that these test results should be carried out with measurements based on cathode current density rather than on e.m.f. However, the weight losses were checked to determine whether an appreciable reduction in corrosion rate could be secured. There appeared to be little benefit from the cathodic protection until an e.m.f. of 1.0 v. was applied. At this point slight gassing was observed at the cathode.

The second series of potential studies were directed toward determining the effect of the film which was observed to form on the carbon steel. Originally, it was found that a considerable potential difference, approximately 0.3 v., existed between stainless steel and carbon steel. This effect disappeared, however, in a short period of time and the stainless and filmed carbon steel were about equipotential. The same condition was found when the filmed carbon steel was connected with a clean, unfilmed carbon steel test piece. The potential difference soon dropped to close to zero. The tests were run with the results shown in Fig. 4. The indications lead to the belief that the cathodic current produces a dense or heavier film on the surface which takes a longer time to penetrate and attack through or, a greater time for the unfilmed steel to develop a comparable protective film. The potential effect of the film is extended in time up to about 1 v. Two volts caused gassing at the cathode during the film-forming operation. The film formed did not show a comparable time-potential difference. Apparently the gassing caused a mechanical breakdown or a chemical reduction of the film with the result that it had little galvanic effect. In order to check on the corrosion rates at this point, tests were run at 1.0 and 2.0 v. with the results shown in Table XI. The penetration rates are calculated over the time exposed to the baths. The results may indicate that the 1.0-v. cathodically protected specimen did have more protection due to the film formed, than the 2.0-v. specimen which corroded at a greater rate. There are other variables present, however, which require more testing and consideration.

Current densities on the 1.0-v. test started at approximately 8.8 amp., dropped rapidly to 5.5 amp. in 1 min., and at the end of the hour were steady at about 3.4 amp. per sq. ft.

CONCLUSIONS

The following conclusions are based on the authors' interpretations of the results of laboratory tests. It is realized that the tests and data shown are incomplete. Some work is under way to fill in some of the gaps. However, more variables constantly show up that might be followed with profit.

Certain of the conclusions which follow are marked by an asterisk. It is the authors' opinion that these are the most important of the group listed.

1. Steel is a variable, not only as to type, but also within those types.
2.* Steel chemistry and type do have a limited effect on corrosion rates.
3.* Cooking liquors may vary greatly in their inherent corrosiveness.
4.* White liquor has a much greater effect on corrosion rates than steel chemistry and type.
5. Higher caustic soda content does not increase corrosion rates.
6. Higher sodium sulphide content increases corrosion rates.
7. Increased carbonate content does not increase corrosion rates.
8. Increased sulphate content reduces the rate of attack slightly.
9. Increased chloride content increases the rate of attack slightly.
10.* Some other chemical compounds in the white liquor, not reported in the normal chemical analysis, have a great influence on corrosion rates.
11. Galvanic effects in digester corrosion do affect corrosion rates.

12. Corrosion rates tend to decrease with time of immersion.

13.* There is no evidence that penetration of the rim of a rimmed steel digester will cause extremely rapid attack on the core steel.

14.* Air in the liquor increases the corrosiveness.

15.* Deaeration, by boiling or flushing, reduces the rate of attack.

16. Air impingement or air bubbles along the surface increases attack.

17.* Baths may react differently to oxidizing or nonoxidizing conditions.

18.* The film which forms on carbon steel in the liquor is cathodic to the unfilmed or wiped surface.

19.* The film effect can be increased by a cathodic treatment.

20. Too high a cathodic current density destroys the film formed due to gas evolution.

21. The protective film formed on the steel tends to be self-healing if not eroded or wiped away.

22.* A very careful and thorough chemical study should be made of baths showing excessive corrosion rates as well as low corrosion rates. This should cover not only the normally checked components, but also the complex sulphur compounds. The presence of oxidizing and reducing compounds should be noted. The gases present in the liquor should be checked.

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New Gloss Tests of Paper Products

RICHARD S. HUNTER

Different procedures are required for gloss measurements of different materials because of: (1) differences in their optical characteristics, and (2) differences in the visual gloss preferences of the technologists who deal with them. The present paper describes the selection of gloss test methods for three types of paper products: (1) waxed paper cups, (2) waxed bread wrappers, and (3) very glossy paperboards. Both the existing TAPPI test methods are shown to be useful for the types of paper for which they are intended, but only one (for 75° specular gloss, T 480 m) is shown to be suitable for one of the three types of products studied (paper cups). For bread wrappers and very glossy paperboards, new optical tests had to be devised.

WITHIN the past year, manufacturers of three different paper products have approached the Hunter Associates Laboratory requesting help in selecting methods for measuring the gloss of their products. In two of the three cases, new measurement procedures had to be developed. In the third case, one of the two standard TAPPI methods for gloss proved suitable, but a special technique had to be developed for mounting and exposing the specimens which in this case were waxed paper cups. It is believed that there may be an interest in the apparatus and procedures used to select these new methods of gloss measurement.

As is generally known gloss is related to the capacity of surfaces to reflect light in and near the specular angle. It can be shown with a goniophotometer, such as is illustrated in Fig. 1, that different surfaces distribute reflected light in many different ways. Figure 2 is a chart prepared on the Hunterlab recording goniophotometer shown in Fig. 1. On it are plotted the distributions of light reflected by a piece of white graph paper, a piece of supercalendered book paper, and one specimen of each of the three groups under study. As is shown on the graph, light was incident at 45° as these curves were being run.

Although the differences in shapes of curves shown in Fig. 2 are quite marked, it can be appreciated that even greater variability will be uncovered as angles of incidence are varied from near perpendicular to near grazing. So great are the gloss differences between different types of materials that the author was able, some years ago, to show that wholly different visual criteria for gloss are used to differentiate specimens of various types. Corresponding to these different criteria are different techniques of gloss measurement. These the author called "types of gloss" in Table I which is taken from one of his previous publications (*1*).

In spite of the potential variety of techniques, most methods of gloss measurement are based on reflectance or relative reflectance in the specular direction. Of the methods discussed below, all but the Ingersoll and TAPPI 75° tests would be said to measure specular gloss. The Ingersoll method measures contrast gloss because specular alone is compared with total reflectance; the TAPPI 75° method would be said to measure sheen because 75° is a near-grazing angle.

MULTIANGLE GLOSSMETER AND REFLECTANCE TESTS USED

All measurements in the present study were made either with the goniophotometer shown in Fig. 1 or with a new multiangle glossmeter which can be set for different angular conditions. Figure 3 is a photograph of the new glossmeter. Figure 4 is a drawing showing positions of the specimen and optical components of the instrument. The different optical elements are attached to blocks which in turn are mounted on the source and receptor arms of the new instrument. These two arms rotate about a central pivot and may be locked in position by means of a large nut.

The important angular dimensions of the instrument are all variable. The directions of incidence and view ($i.v$) vary with positions of the two arms. The source and receptor field angles ($\omega_i\omega_v$) vary with the source and receptor stops which are holes cut in brass plates that fit into slots in the blocks.

In all the measurements reported, the specular angle was used; i.e., i always equaled v. Some of the specular and field angles used for the measurements reported below are given in Table II. It will be seen that the conditions of measurement of two TAPPI and one ASTM gloss method were readily duplicated in the

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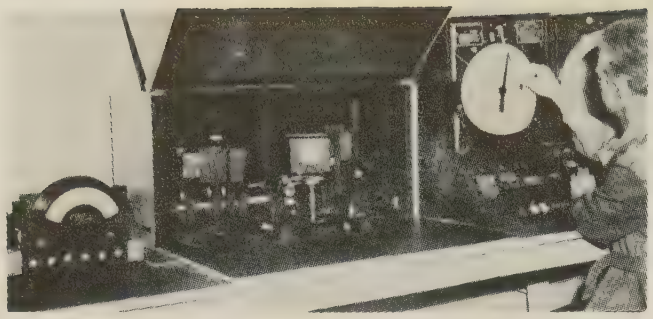


Fig. 1. New Hunterlab recording goniophotometer showing search unit with light source and phototube in the center, logarithmic amplifier on the left, and recorder on the right

new instrument. The two most important angles for each procedure in Table II are the incidence angle i, and the receptor field angle in the plane of measurement. This latter angle is important because it determines the width of the specular peaks of reflectance from different surfaces (see Fig. 2) which will be accepted for measurement as specular reflectance. These two angles are used to identify the various test procedures below.

For measurements to simulate those of the Ingersoll Glarimeter (*2*), the receptor stop was completely removed to simulate the large 12° source stop of the Ingersoll visual instrument. (Interchange of source and receptor field angles is permitted according to the Helmholtz reciprocal relation (*3*).) A piece of polaroid was placed in the slot normally occupied by the receptor stop, being turned first one way for measurements of half the so-called diffuse component alone, and at right angles to this position for measurements of the other half diffuse, plus the whole specular component. The ratio of difference to sum of these two quantities $[S/(S\text{-}D)]$ is the quantity reported as per cent gloss by TAPPI standard T 424 m-45.

A single standard of polished black glass was used for all the measurements reported, except those for the Ingersoll method which requires no standard.

Because the present study shows that the two published TAPPI methods for gloss measurement are unsuitable for two of the three groups of paper products submitted, five specimens were added to show that the published TAPPI methods are well suited for the materials for which they are intended. Figure 5 is a photograph which compares two pieces of graph paper. One (G) has a noticeable tendency to glare when improperly positioned with respect to a source of light. The other graph paper (B) shows much less glare when it is located so as to reflect specularly to the eyes of the user. Figure 6 compares measurements of these two graph papers by the first four procedures listed in Table II. It shows that the Ingersoll test, which is intended to measure the tendency of uncoated papers to glare, gives the best numerical separation of the two specimens.

Figure 7 is similar to Fig. 5 except that the two graph papers have been replaced by three supercalendered book papers. These three papers are quite close in gloss and came to the author because of an argument over their proper method of measurement. Visually, no. 80 is the glossiest, 79 the least glossy, with 81 in between. (Their numbers are believed to be the Ingersoll values obtained by the previous investigator.)

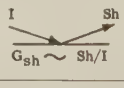
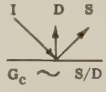
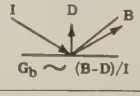
Figure 8 shows results from these three papers with the same four gloss procedures as before. Again, it is seen that the method intended for this type of paper (the 75° method variously called modified Oxford, Bausch and Lomb, or TAPPI T 480 m) (*4*) gives the steepest curve and properly designates no. 81 as lower in gloss than 80. The Ingersoll test, on the other hand, assigns no. 81 a higher value.

MEASURING THE GLOSS OF WAXED PAPER CUPS

Four of the six waxed paper cups submitted for gloss investigation are shown in Fig. 9. To measure properly the gloss of these cups, it was necessary to isolate a slit-shaped area on the side of each cup so narrow that departures from flatness within this area due to curvature of the cup would not noticeably affect the spread of light being measured for gloss. In the present study, a slit $^1/_{16}$ in. wide lying in the plane of the drawing was substituted for the aperture stop shown in Fig. 4.

Next, a set of four metal fingers was substituted for

Table I. Tabulation of Six Appearance Criteria for Gloss

Type of gloss	*Perceptual (appearance) aspect*	*Reflectance function*	*Classes of surfaces involved*
Specular gloss	Shininess, brilliance of high lights		Medium gloss surfaces of plastics, etc.
Sheen	Shininess at grazing angles		Low gloss surfaces of paint, paper, etc.
Contrast gloss	Contrast between specularly reflecting areas and other areas		Low gloss surfaces of paint, textile cloth, etc.
Absence-of-bloom gloss	Absence of haze, or milky appearance adjacent to reflected high lights		High, and semigloss surfaces in which reflected high lights may be seen
Distinctness-of-image gloss	The distinctness and sharpness of mirror images	Not yet measured as function of reflectance	High gloss surfaces in which mirror images may be seen
Surface-uniformity gloss	Surface uniformity, freedom from visible nonuniformities	Not function of reflectance	Medium to high-gloss surfaces of all types

the two parallel plastic bars used to locate the specimen on the glossmeter as it is shown in Figs. 3 and 4. These four fingers have to be carefully positioned so that when a paper cup is dropped into the cradle formed by them, a slit-shaped area along one side will occupy the same plane as the face of the panel in Fig. 3. To properly locate the fingers, a piece of metalized plastic was taped to the side of one cup to provide a mirrorlike surface of the same curvature. The strong beam of light reflected by this curved mirror could be used to tell when the cup was properly located for gloss measurement.

The results for the six cups by the four test methods are plotted in Fig. 10 against the gloss rankings of the cups made visually. The results suggest that the TAPPI 75° method number T 480 m separates the specimens as well as any of the four tried.

In the curve at the top is shown the failure of the Ingersoll values of contrast-gloss to compare properly specimens of different color. Specimen no. 6 plotting at the right side of the chart is white in color, no. 5 at the left is dark red, while the other four are pink. Because diffuse and diffuse plus specular components were measured separately in the present test, it was possible to compute the Ingersoll values which would have been assigned specimens 5 and 6 had they been pink instead of white and dark red respectively. The effect of this change on their gloss values is shown by the dotted lines of the Ingersoll curve in Fig. 10.

METHOD FOR HOLDING SPECIMENS FLAT

The remaining two groups of specimens are quite glossy as is shown by the peakedness of the curves representing them in Fig. 2. As the specimens to be intercompared become glossier, the flatness of surface during measurement becomes more critical. When high gloss surfaces are curved or warped, the eye recognizes the presence of curvature by the distortions of images seen reflected in them. These distortions of image shape do not detract from the apparent gloss of the surfaces as does fuzziness of reflected images due to

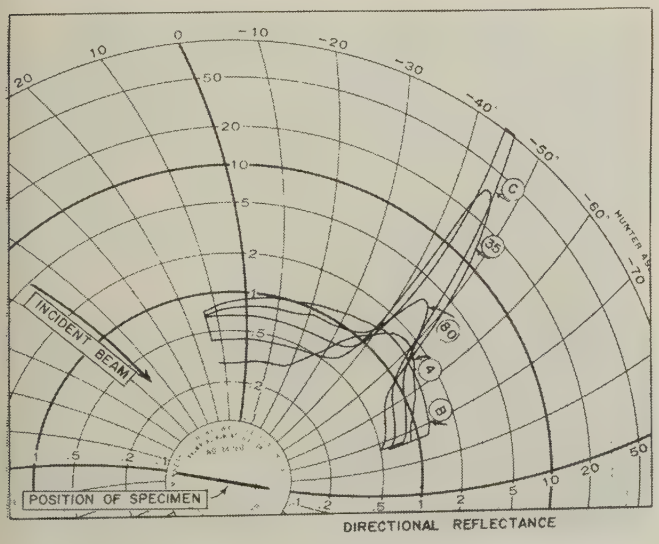


Fig. 2. Goniophotometric curves obtained with the recorder shown in Fig. 1 using light incident at 45°

C—white paperboard with special high-gloss coating; 35—waxed bread wrapper; 80—supercalendered book paper; 4—waxed cup (pink); B—white graph paper.

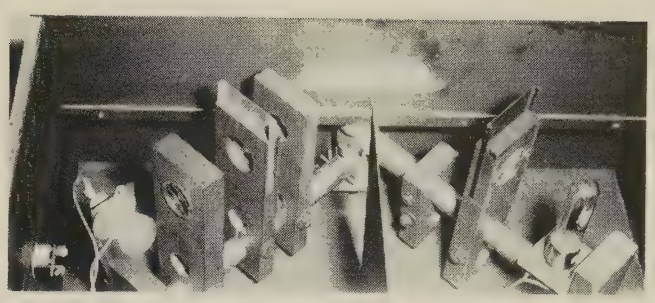


Fig 3. Interior of multiangle glossmeter showing source and receptor arms which swing from pivot and blocks which mount on them to hold lenses, light source, photocell, and stops; exposed face of specimen can be seen at top

lack of mirror quality. Although the eye thus distinguishes between these two types of image distortion, reflectance measuring instruments cannot. They respond alike to loss of specular beam light due to fuzzy images and misshapen images arising from surface curvature. It is therefore essential that curvature be eliminated in order to measure glossy appearance.

During the work with waxed bread wrappers and very glossy paperboards, a number of methods were tried for holding these materials flat during measurement. The three which were used are shown in Fig. 11.

A fourth has just been described in another study* of high gloss papers.

At the left is a piece of waxed bread wrapper mounted in an ordinary embroidery hoop. This type of device is readily available but it is somewhat difficult to use, particularly when tension must be reproduced from one specimen to the next.

A readily available material of excellent rigidity and flatness is plate glass. Two methods were tried for mounting paperboard on plate glass. In the center is shown a piece of photographic dry-mounting tissue on the plate glass panel with the cardboard behind ready to place on top. A household iron operated at low heat was used to warm the sandwich until the thermosetting resin of the mounting tissue adhered to the cardboard and the glass. This method worked well on the glossy paperboards. However, the combination of heat and mechanical pressure required is obviously unsuitable for paraffined papers, and might damage other fragile surfaces.

Two-sided pressure-sensitive tape was used as the second adhesive. Specimens are readily attached to glass panels covered with this tape. No heat and merely pressure enough to provide contact are required for this method of mounting. The four waxed-paper panels shown in Fig. 11 were prepared in this manner.

GLOSS RECORDER FOR BREAD-WRAPPER WAXING MACHINE

Four of the large group of waxed paper specimens submitted in this study are shown in Fig. 11. The paper manufacturer submitting these specimens asked not only for a suitable gloss scale but for an instrument which could be used on his waxing machine to record and control the gloss of his product.

All details of the controlling mechanism were left to the paper manufacturer. The Hunter Associates Laboratory undertook to build a photoelectric search unit and to modify one of the standard electronic re-

* In their paper in the Dec. 1953 issue of *Tappi*, Wink, Delevanti, and van den Akker describe a sintered-bronze porous disk which was ground flat and used as a suction plate to hold high gloss papers during measurement.

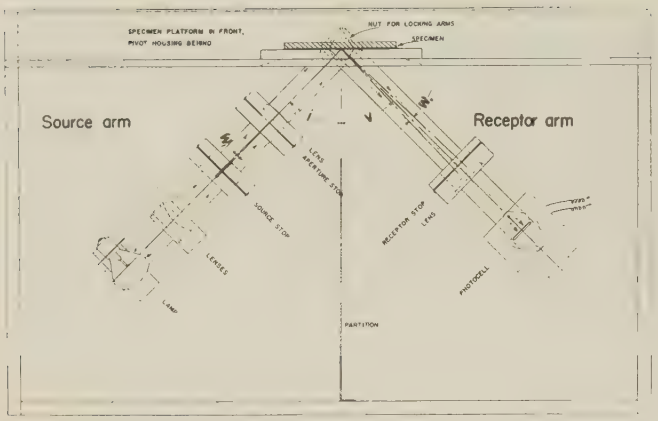


Fig. 4. Drawing of multiangle glossmeter showing locations of optical components and the angles which establish the geometric character of any reflectance measurement made with the instrument

i, angle of incidence; v, angle of view; ω_i, source field angle; ω_v, receptor field angle. Stops are interchangeable, being cut in brass plates which slide into slots in the blocks.

corders so that together the two units would measure the differences in gloss found in the waxed bread wrappers submitted. Figure 12 shows results by four test methods on the four panels illustrated in Fig. 11. In this figure, it will be seen that three of the four methods give roughly equal numerical intervals. Actually, the 75° method gives an interval between lowest and highest of 28, the 60° method an interval of 31.5, and the 20° method an interval of 32.4.

For this control application, the instrument needed to respond only to the gloss range covered by waxed bread wrappers, not the whole range up to black glass. There was thus no reason why the numerical scale could not be limited so that the glossiest bread wrappers read near the top. If ratios of highest to lowest gloss values are computed for each of the four sets of data represented in Fig. 12, the numerical interval will be much the greatest for the 20° method because its values will undergo greatest magnification. Such an adjustment of scale range was actually made.

The recording glossmeter designed for waxed bread wrappers is shown in Fig. 13. The geometry used in the photoelectric pickup is actually 25 × 3.3°, not importantly different from the 20 × 4.4° geometry used to obtain the data shown in Fig. 12. As with the ASTM 60° method, the receptor stop is slit-shaped, measuring 11.5° across the plane of measurement. This slit shape is needed to accommodate the spread of mirror-reflected light caused by curvature of the roll over which measurements are made. As with the paper cups, effect of this curvature was minimized by exposing a narrow strip of specimen along the roll.

In Fig. 13 showing the apparatus in our laboratory, the exposure unit with lamp and photocells is mounted over a piece of bread wrapper stretched across a curved sheet of chrome-plated steel. This curved sheet of steel was used to simulate the roll of the waxing machine where the unit is to be mounted. With the paper removed, the mirror surface gave a sharp beam for use in aligning the device. Needless to say, accurate maintenance of exposure unit position and its optical adjustment are necessary with any high-gloss recorder such as this.

To eliminate effect of voltage fluctuation from the recorded values of gloss, ratio measurements of currents from the two photocells were used. For measurements of specular gloss, the second photocell was situated to view the lamp directly. (It is on the right just above the wires in Fig. 13.) The recorder measures the ratio of outputs of the two photocells.

As a possible means of sharpening the sensitivity of the machine to gloss differences and at the same time decreasing its susceptibility to errors from dust on the single lens, a modification of the specular-gloss method was tried. On either side of the central specular photocell were mounted photocells in approximately the position occupied by the edges of the receptor stop shown in Fig. 4. The small black box in which they are housed with the central specular photocell faces the bread wrapper from behind the partition seen in Fig. 13. The light received by these two photocells may be called near-specular. Because their total exposed area was much greater than that of the central specular photocell, the total current output of the two NS photocells was always the greater. The recorder could thus be made to read specular divided by near-specular reflectance, the whole multiplied by some constant of proportionality determined by the relative exposed areas of S and NS photocells. In the following table are listed the contrasting advantages and disadvantages of the S/Ref and S/NS scales.

Contrasting Advantages of Two Scales

S/NS scale	*S/Ref scale*
1. Light to all photocells passes through single lens, thus dirt on the lens should not affect scale reading.	1. NS current is seriously affected by diffuse reflectance (color), but S is not. Hence S/Ref values of gloss will be effected negligibly by the color of the paper being observed.
2. In theory, at least, S/NS should give better numerical differentiation because near-specular reflection falls off as specular increases.	2. The S/Ref scale may be adjusted to standard with a screw, the S/NS cannot.
	3. The NS cells are the most easily affected by stray light from outside; therefore, S/Ref values are less likely to be in error from strong outside light.

So far as the author knows, the waxing plant where this new instrument is installed is still experimenting with both scales and has not yet selected one in preference to the other.

MEASURING THE GLOSS OF VERY GLOSSY PAPERBOARDS

As its objective, this last study seeks to find the

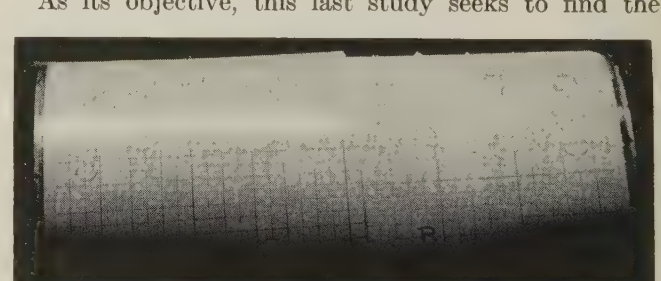


Fig. 5. Two graph papers mounted over segment of cylinder so as to show difference in gloss. (Difference artificially measured by photo grapher)

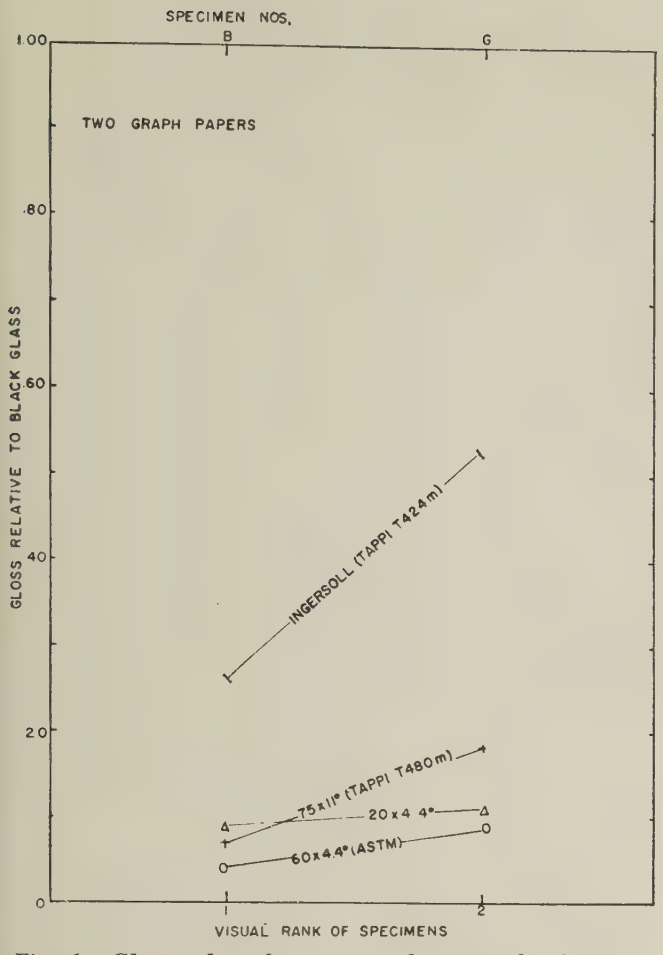


Fig. 6. Gloss values for two graph papers by first four methods in Table II; note that the Ingersoll-type polarization method gives best numerical separation of the two specimens

single-exposure method of reflectance measurement which gives numbers correlating most closely with ratings of very glossy paperboards. The 11 specimens selected were the ten paperboards and one mounted piece of paper which are shown in Fig. 14 and described in Table III.

The problem of reflectance measurement presented by these 11 specimens is more difficult than any of the four described above because: (1) The concentration of specularly reflected light by these boards (see Fig. 2) necessitates precise angular control of any conditions of measurement adopted for them. (2) The

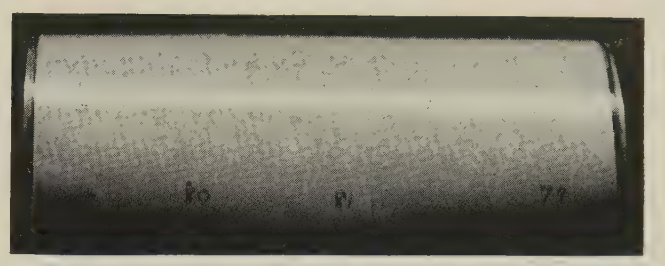


Fig. 7. Three supercalendered book papers stretched over a segment of cylinder to show gloss differences decreasing from left to right

surfaces of different composition and preparation to be intercompared have reflection distributions which differ in manners that cannot be completely described by reflectance for any single set of geometric conditions. This is shown by the different shapes of the curves of Fig. 15 which are magnified traces of the specular peaks of the 11 specimens. Note that the peaks differ both in height (corresponding to shininess), and narrowness (corresponding to image sharpness).

Before any movements were made, the 11 specimens were rated visually by five different observers, none of whom were paper technologists. Three of these observers used the transparency illuminator with wire screen shown in Fig. 14, the other two rated the specimens for gloss by observing images of overhead fluorescent lamps and window mullions. The gloss rankings of these five observers together with the average ranking of each specimen are given in Table III. In Fig. 14, the specimens are arranged according to average ranking.

Next a piece of each specimen was mounted on a plate glass panel using photographic dry-mounting tissue and a household electric iron at low heat in the manner described above.

The first goniophotometric curves of the resultant panels were made with light incident at 45°, first across, and then parallel to the long direction of each panel. It was the purpose of these measurements to determine the extent of ribbing of the specimen surfaces and find for each the direction giving the highest and narrowest goniophotometric curves.

After the high-gloss orientation of each specimen was identified, goniophotometric curves (the specular-reflection peaks) of all 11 specimens were made first for 45°, then for 60°, and finally for 20° incidence. Because, as is shown in Fig. 2, these high-gloss specimens have narrow peaks, the chart of the goniophotometer

Table II. Tests Used for Gloss of Paper Products

For positions of specular and field angles, See Fig. 4

Specular angle i (=v) *and name*	*Field angles, deg (first angle given is in plane of measurement)* *Source, ωi*	*Receptor, ωi*	*Published test methods*	*Applications*
57½° Ingersoll Glarimeter (*2*) contrast method	12 × 12	Very small	TAPPI T 424 m-45	Measure uncoated white papers for tendency to glare when improperly lighted. Customs test of newsprint
75° modified Oxford method	2.8 × 5.7 (maxima)	11.4 diam.	TAPPI T 480 m-51 ASTM D 1223–52 T	Measure supercalendered book and certain other coated papers for shininess
60° ASTM specular-gloss method	1 × 4 (maxima)	4.4 × 11.7	ASTM D 523–53 T	Classify paints, plastics, and like materials as high, medium, or low in gloss. Measure these same materials for shininess, except when very glossy, or very dull
20° test for waxed bread wrappers	1 × 4	4.4 × 11.7	None	Record and control the gloss of waxed bread wrappers at the waxing machine
60° test for very glossy paperboards	0.5 × 2	0.5 × 4	None	Intercompare cast, lacquered, and other very glossy paperboards for glossy appearance

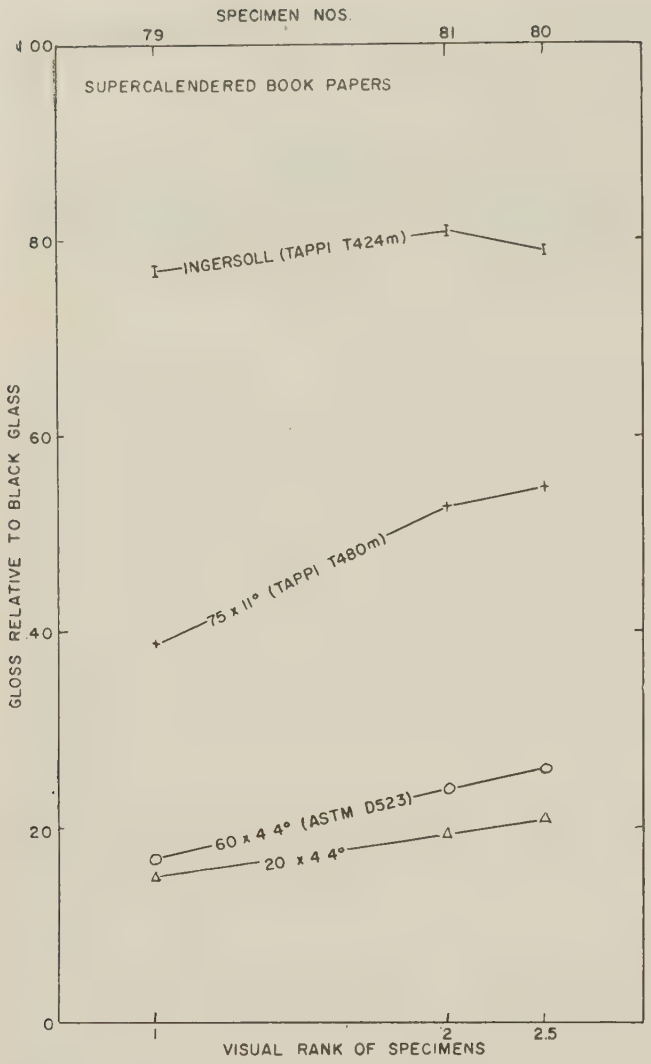


Fig. 8. Gloss values for supercalendered book papers by first four methods in Table II plotted against their visual gloss rankings

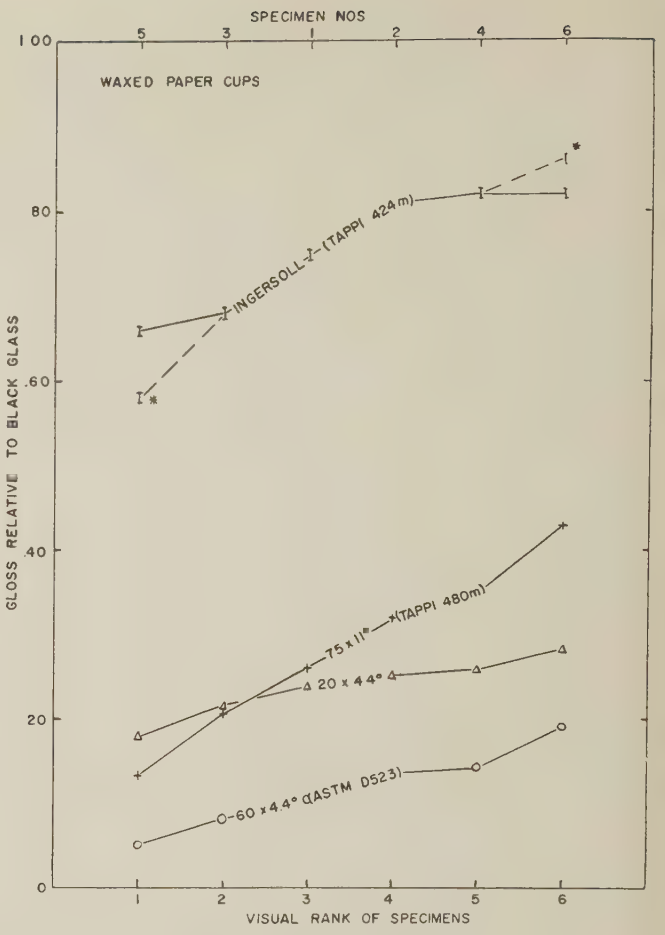


Fig. 10. Gloss values for waxed paper cups by first four methods in Table II plotted against visual gloss rankings

Measurements were made on a slit-shaped area on the side of each cup so as to provide a near-flat area for test. Asterisk denotes values cups would have had, had they been pink like the other four specimens.

was run at ten times the actual searching rate so as to magnify angular differences in light distribution. The curves for 60° are shown in Fig. 15. These were selected because the heights of the peaks of the 60° curves corresponded most closely to the visual rankings in Table III.

The curves in Fig. 15 show that measurements of the peaks of the specular-reflectance distributions at 60° should rate these specimens in nearly the same manner as did the majority of observers. However, it is obvious that these measurements must be restricted to narrow field angles if only the peaks of the distributions are to be compared. The narrow peak of the curve for cast-coated specimen K is only 0.7° wide between values of half of its peak intensity.

This necesity for narrow field angles in any measurement of the gloss differences between these panels is also apparent from Fig. 16. Values of gloss by the four methods used on the previous materials are shown to be in very poor agreement with visual rankings of these panels. In particular, the cast-coated specimens K and P read much lower than most of the other specimens by all four previous methods. This failure would be expected from the distribution curves of Fig. 15 which show the integrated areas under the curves representing the two cast-coated speci-

Fig. 9. Photograph showing gloss differences between four of the six cups for which values are given in Fig. 10

From left to right in the order of decreasing gloss are specimens 6, 4, 1 and 5.

Fig. 11. Four waxed bread wrappers afixed to plate glass panels by pressure-sensitive tape; these are exposed in front of wire screen so as to show gloss differences between them

Table III. Paperboard Specimens of Very High Gloss and Their Gloss Rankings by Five Observers

Specimens	Gloss rankings by observers RH	EH	MP	HH	IN	Av.
E Special-coated white board	1	1	1	1	1	1.0
LE Cast-coated and lacquered cover stock (light blue)	3	2	2	2	2	2.2
C Special-coated white board	4	3	3	3	3	3.2
K Cast-coated white board	2	4	4	6	4	4.0
A Special-coated white board	6	5	5	5	5	5.2
B Special-coated white board	8	6	6	4	6	6.0
D Laminated white board, special coating	7	7	7	7	7	7.0
P Cast-coated white paper on board	5	8	8	8	8	7.4
RC Latex-coated white board	9	9	9	9	9	9.0
80 Special-coated white board	10	10	10	10	10	10.0
LA Lacquered white board	11	11	11	11	11	11.0

mens to be less than under the others because of the narrowness of the peak of the cast-coated curves.

When reflectance measurements are made with source and receptor field angles reduced to 0.5° in width, results with the instrument begin to agree with ratings made visually. Those at 60° are better than those made at either 20 or 45° because at these smaller angles, the cast-coated specimens are again ranked too low.

It is apparent from the three curves at the bottom of Fig. 16 and from the sets of goniophotometric curves—only one of which is reproduced here—that the cast-coated specimens increase in relative specular reflectance as angle is increased. One can thus by variation of incidence and field angles cause the reflectance values of these specimens to increase or decrease at will relative to those of surfaces prepared by other methods. For glossy appearance, the proper method of measurement is that which gives specimens the same numerical rankings as do unbiased observers. Figure 16 shows the 60 × 0.5° method to be the best of those tried in giving agreement with ratings of the five observers used.

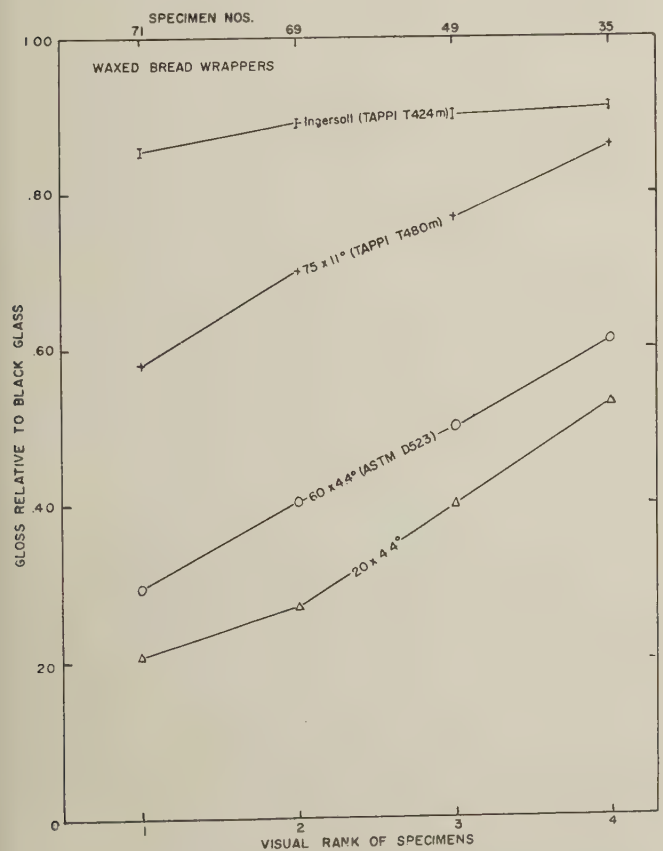


Fig. 12. Gloss values for waxed bread wrappers by first four methods in Table II plotted against their visual gloss rankings

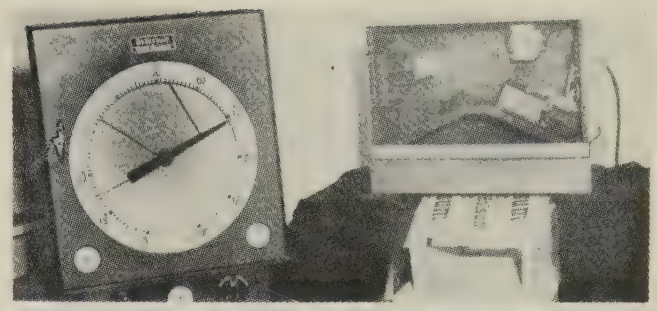


Fig. 13. Gloss recorder and controller for waxed bread wrapper being tried in the laboratory

Wrapper is stretched over sheet of chrome-plated steel bent to simulate the curvature of the roll in the waxing machine where the unit will be mounted.

There is in the newly printed version of ASTM Method D 523 for specular gloss (*5*) a procedure intended for high-gloss surfaces. However, its dimensions are 20 × 2.8°. Actual measurements by the newly published method, which are not reported for lack of space, confirm the foregoing conclusion that 20° is too small a specular angle, 2.8° too large a field angle for the proper ranking of this set of very glossy paperboards.

On the subject of high gloss, mention may be made of two recent test procedures which do not use values of reflectance. Nimeroff (*6*) has recently proposed measurement of the statistical kurtosis factor applied to goniophotometric curves of specimens as measures of their gloss. This is rather a tedious measurement since it requires the taking and reading of goniophotometric curves. Still more recently, Middleton (*7*) has developed a rotating-sector, electronic sharpness-of-image glossmeter which gives direct indications of gloss. This latter instrument seems quite promising.

After the present manuscript was prepared, the paper by Wink, Delevanti, and van den Akker, "A Goniophotometric Study of High-Gloss Papers," appeared in the December 1953 issue of *Tappi*. They give many more goniophotometric curves of high-gloss papers than appear in the present report, but their conclusions are essentially the same. They emphasize the fact that different methods of gloss measurement are necessary for different types of papers.

They measured refractive index and report that most high-gloss papers appear to fall into two groups with refractive indices near 1.3 and 1.55, respectively. This grouping could account for the pronounced differences between high and low points on the 20 × 4.4° and 60 × 4.4° curves in Fig. 16.

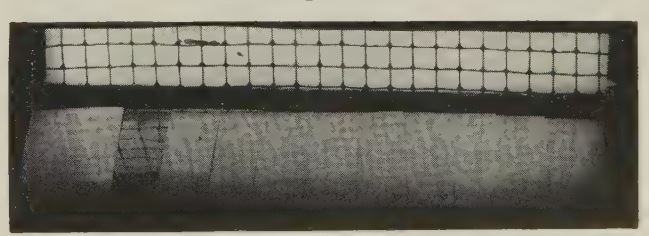


Fig. 14. Eleven paperboard specimens arranged in front of wire screen in same order in which they were ranked visually

In addition to the heights of the peaks of the goniophotometric curves, they measured narrowness or peakedness of curves as an indication of gloss. Such a measure has much to commend it.

If in view of the widespread interest in these new boards and papers, there is a move to develop a standard gloss test for them, consideration should be given to the 60 × 0.5° method found best for the present group of specimens. It has the advantage of being simpler than the various goniophotometric tests, but it should not be adopted without trial on a wider selection of specimens than was used for the present study. For any standard method that may be selected, special attention will have to be given to geometric details of specimen flatness and positioning and alignment of instrument parts.

SUMMARY

Gloss is a consequence of skin structure and composition as evidenced by the capacity of surfaces to reflect light in and near the specular angle. There is no specific reflectance function which can be used for for the gloss differentiation of all types of surfaces. The capacities of surfaces to reflect light in and near the specular angle vary greatly, even for specific orientations and directions of incidence. As a consequence, the best that can be done for practical routine measurements of gloss is to find for each different class of surface the specific conditions of reflectance measurement which most closely reproduce the gloss ratings made visually.

In other words, procedures for gloss measurement vary with: (1) character of materials to be measured, and (2) visual gloss preferences of technologists who work with these materials.

In the present investigation involving three types of papers newly studied for gloss and two types previously measured, it has been shown that:

1. TAPPI standard T 424 m-45 based on the Ingersoll Glarimeter is, as intended, well suited for rating the tendency of uncoated papers to glare.

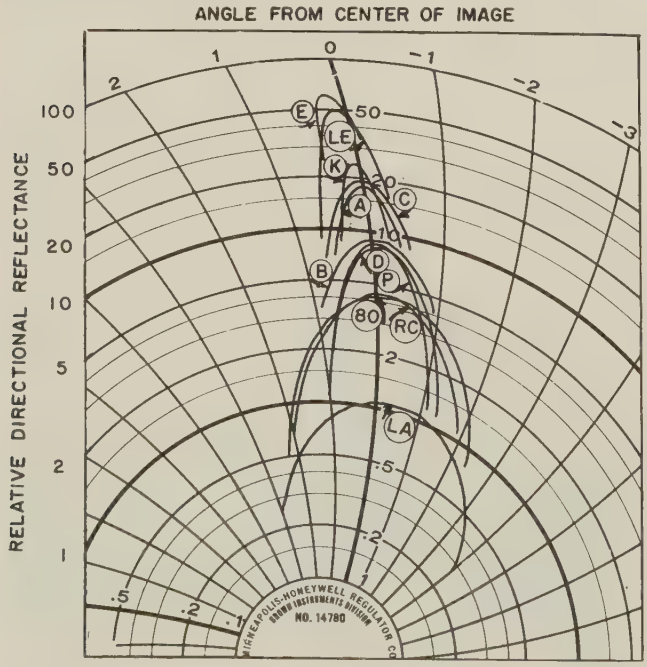


Fig. 15. Peaks of the goniophotometric curves for the 11 specimens shown in Fig. 15; angle of incidence, 60°

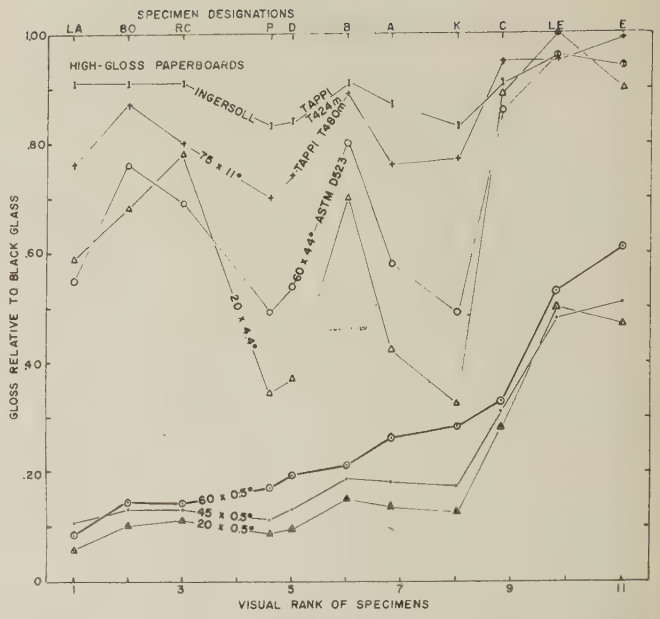


Fig. 16. Gloss values for 11 paperboard specimens by seven different methods of measurement plotted against their visual gloss rankings

2. TAPPI Standard T 480 m-51, known as the modified Oxford or Bausch and Lomb method, is also well suited for the purpose for which it was designed, namely to differentiate coated book papers.

3. This same 75° method appears well suited for rating the gloss of waxed drinking cups, provided precautions are taken to limit the area of each cup exposed to an essentially flat narrow strip along the side.

4. For the most effective gloss differentiation of waxed bread wrappers, specular-reflectance measurements at an angle less than 45°, with receptor field angle about 4° wide seem to be indicated.

5. For very glossy, cast-coated, lacquered, and special-coated paperboards, specimens must be held perfectly flat and measured for specular reflectance with narrow field angles (0.5° was used). To give the surfaces of the present study their proper relative rankings, a specular angle of 60° proved best.

The trend toward multiplicity in methods of gloss measurement will obviously be disappointing to paper technologists seeking simplicity. However, the increased variety of gloss tests may be counteracted in part by new instruments, such as the multiangle glossmeter which is suitable for a wide variety of measurements of gloss.

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Ash in Sulphite Pulp

F. WULTSCH AND F. SENGER

Reference is made to the importance of the total ash content in pulp, and the individual elements of the latter, especially with regard to further chemical processing and the resulting paper finishing methods. Investigations were made with regard to calcium, magnesium, iron, manganese, copper, lead, silica, and sulphur in those stages of pulp production in which a change in the amount and composition of ash were to be expected (10 stages in production). The results are clearly shown by means of diagrams and tables. The term "ash capacity" which is a function of mechanical reactions (removal of pulp flour) and chemical reactions, is also explained. Especially striking is the dissolution of sulpholignin during the pulp processing, resulting in a reduction in ash capacity. The bleaching process (formation of carboxyl groups) on the other hand will increase it. The amount of ash and its composition are also influenced by changes within the ash capacity. These changes are exchange reactions of ions. Reactions of adsorption and precipitation are of minor importance. A specific de-ashing (removal of undesirable ash substances, for instance iron or manganese) may be obtained when the cations are passing over into complex ions, being quantitatively removed with the process water. Methods of analyses are described.

In addition to cellulose and organic impurities technical wood pulp contains small amounts of mineral and inorganic substances which may be isolated by ashing. In the following they will be termed, ash.

In various connections, reports have appeared frequently regarding the individual proportions of this ash. However, total analyses were limited to a weight determination. The importance of small amounts of salts and oxides has been shown by the development of catalytic reactions. The pulp is subject to a chemical purification process in a continuously increasing ratio, even in paper production itself where chemical changes take place in the beater and on the paper machine by polymerization and condensation reactions of added odd materials. Therefore it is necessary to pay more attention to the ash in pulp with this point of view in mind.

It has been frequently proved that certain elements, such as iron, manganese, silicon, or calcium, are a disturbing influence. Without claiming to deal fully with this subject some of these disadvantageous factors will be discussed.

According to Lottermoser and Wultsch iron (*1*) and manganese (*2*) interfere with the process of rayon production during the preripening of the alkaline cellulose, while copper has the same effect upon the course of ripening of the viscose solution. Furthermore, iron and copper, if present in the pulp at the sulphide treatment of the alkaline cellulose, cause a dark coloring of the viscose solution and will give the rayons a yellow tinge. Heavy metal cations, because they accelerate bleaching, often cause troubles in the bleaching process (*3*). Copper and manganese operate as a rubber poison, and will considerably reduce, even in minutest quantities, the durability of gummed textures (*4*). Calcium and magnesium lead to a plugging of jets and thus diminish the strength of the rayon. Likewise silicon dioxide is undesirable. Plugging of filters will increase with high contents of silicon dioxide (*5*). Photographic and filter papers must be practically free from any metal. The ash content of condenser papers must be kept as low as possible since ash will increase the conductivity and therefore diminish the dielectric strength (*6*). Also the tendency for turning yellow will increase. Discoloring will be caused mainly by the ferro-salts which afterwards oxidize to ferri-salts (*7*).

Therefore it seemed of interest to us to investigate the reaction of ash substance, its composition, and its varying proportions in wood pulp production.

We have therefore attempted to answer the following questions: (1) the manner of combining, principles of absorption and removal of the ash formers, (2) origin of ash formers, and (3) possibilities to control the amount and composition of the ash content.

EXPERIMENTS AND RESULTS

The sequence of experiments and the process of investigation will be explained after a critical review of the results.

Investigations were made in the wood pulp production departments or stages in the production process, where changes in the composition of ash, or quantitative changes were to be expected, namely: (1) wood during the filling, (2) pulp from the blow pit, (3) after screening, (4) after thickening, (5) after the first filter A, (6) after the last filter E, (7) after chlorination, (8) after bleaching, (9) after acidifying, and (10) after the fourdrinier (see Fig. 1).

We investigated particularly, calcium, magnesium, sulphur, silicon, iron, manganese, copper, and lead contents for variations in the proportions of the ash substance at the different process stages.

Figure 2 represents the total ash content in the different stages of production (see also Table I).

Two maxima result corresponding to cooking and bleaching, respectively.

The "washing processes" following each will lead to a minimum. The upper limit seems to be determined by the conditions of cooking and bleaching, while the lower is fixed by the hardness of the water and the method of washing. An interpretation of the curves will be given following the determination of those portions of ash that account for most of the ash content, i.e., alkaline earths and sulphur.

Figures 3, 4, and 5 or Table I, respectively, show the resulting curves of the latter two.

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It is striking to see that CaO and SO_3 will decrease in a similar way during the course of processing, while MgO will increase in a comparatively high degree. If we chart these components on a diagram and choose a milliequivalent as a unit in order to be able to compare them with one another, and, furthermore, show the amount of MgO and CaO in relation to SO_3 as has been done in Fig. 6, a clear parallelity of both these curves from the blow pit to filter A will be seen.

It should be noted that all curves shown here represent only a typical example and no specific case. The parallel trends point to a close connection between the sulphur contained as lignosulphonic acid in the pulp and the calcium removed at this stage or the magnesium absorbed. It must be assumed that in the processing a continuation of the second type of reaction of the cooking process takes place, i.e., a dissolution of lignosulphonic calcium.

The ash reduction will result not only by the solubility of lignosulphonic acid calcium, as pointed out by Wultsch (*2*), but also by the loss of short fibrous pulp (pulp flour, ray cells) with the water during washing. According to reported findings the pulp flour is the principal carrier of manganese. Such a localization of distinct kind of cations is only possible if the development takes place according to the laws by which the exchange reactions are governed. Therefore, the presence of manganese in the pulp flour signifies an approximate calcium content of the latter in proportion of calcium to manganese existing in the total ash. Experiments confirm that the pulp flour has a high ash content (high calcium content).

The phenomenon of the ion exchange has been used in cellulose chemistry to explain certain reactions (*10*). Greater significance was attributed to those properties of pulp by Kullgren (*8*) in treatises on the sulphite

Table I

	Total ash, %	*CaO*		*MgO*		*SO_3*	
		% of ash	*% of pulp*	*% of ash*	*% of pulp*	*% of ash*	*% of pulp*
Wood	0.24	43.80	0.1051	7.38	0.0177	04.21	0.0146
Blow pit	1.34	47.19	0.6323	2.33	0.0312	46.34	0.6209
Screening	0.96	48.00	0.4610	4.99	0.0479	42.77	0.4106
Thickener	0.90	48.32	0.4349	5.39	0.0485	41.28	0.3715
Filter A	0.87	48.66	0.4231	5.92	0.0518	41.37	0.3598
Filter E	0.53	48.75	0.2586	7.74	0.0411	41.14	0.2199
Chlorination	0.86	78.10	0.6717	4.00	0.0344	14.42	0.1240
Bleaching	2.06	81.54	1.6800	0.77	0.0160	03.66	0.0750
Acidifying	0.42	75.38	0.3166	3.75	0.0150	14.26	0.0599
Wet machine	0.48	78.10	0.3749	3.86	0.0186	12.22	0.0583

At first glance this result is surprising, because heretofore, such further reaction was attributed solely to the bleaching process. The nonsulphonic lignin is not being considered here. However, the SO_3 curve will show that of the 7.75 mq. (milliequivalent) SO_3 originally contained in the pulp 5 mq. will be removed during the processing and only 2 mq. during the bleaching.

According to Hägglund the hydrolysis of the sulpholignin carbohydrate complex is a function of the H-ion concentration in the surrounding suspension medium. The latter, however, increases very rapidly, and cannot influence to any degree the reaction noted above, as shown by the pH curve in Fig. 7.

Thus the old controversy regarding the speeds of reaction is shown in a new light. It cannot be disputed that H-ion hydrolysis is involved. However, according to Kullgren (*8*) and Du Rietz (*9*) only the H-ions in the solid phase are those which will be effective here. In solutions with higher salt content, as present during the cooking period, hardly any difference exists between the solid and liquid phase. In highly diluted solutions, such as process water, this difference may be considerable, and the H-ion concentration can be very large within the pulp although the surrounding water reacts almost neutral. This is the case here.

In this way the phase of reaction is explained, and confirms the assumption of Du Rietz regarding the heterogeneous distribution of ions in the pulp, and of the ion-concentration in the fiber which alone determines the speed of the reaction.

Furthermore, CaO and MgO decrease sharply from filter A to filter E, but SO_3 decreases to a lesser degree. cooking process. More recent essays (*9*, *11*), however, demonstrate that this definition is more valuable and more generally applicable than has been realized up to now when explaining the reactions of cellulose material. In nearly all the reports on this subject it was understood that the pulp properties should be taken into consideration at practically any stage in this operation, especially when pulp and solutions are in close contact such as may be the case in the cooking and bleaching process and washing of pulp, the sizing of paper and analytical tests of pulp.

After bleaching we find conditions in the slushed pulp entirely different. The slushed stock shows a greatly increased salt concentration as compared with the process water. The fiber has been subjected to an oxidizing reaction which resulted in the setting free of the remaining lignin substances and led to the formation of carboxyl groups remaining in the pulp. The capacity of interchangeability has increased; therefore, the ash content increased at a given concentration. The hydrogen ions introduced into the system by acidulation will vary the ratio of concentration in the slushed stock and likewise in the fiber. Hydrogen ions replace calcium ions, and the ash content will decrease.

In the washing of the pulp with process water it is to be expected that the reverse will take place, i.e., the exchange of calcium ions for hydrogen ions. As shown in the last section of the calcium curve this is actually the case. Thus the observation by Rys and Bönisch (*12*), as shown in Fig. 7a, is explained. Increase in ash content depends on the washing time. A pulp slightly treated with acid for 30 min. was intensively dewatered and washed with process water of

12.8 d.H. (German degrees of hardness). During the first stages of washing the loss of flour stuff* exceeds the exchange reaction, but after removal of the flour the latter reaction controls.

In Fig. 6 the units are stated in milliequivalents. It may be seen that a considerable part of CaO (31%)

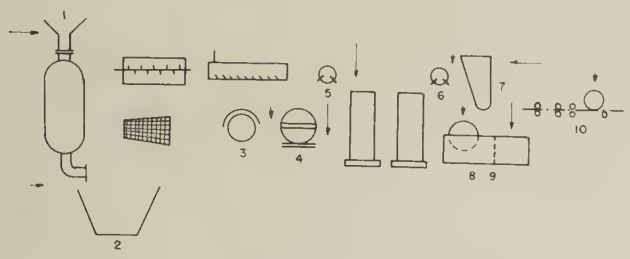

Fig. 1

is not combined with sulphur. To the objection that the total sulphur would not be determined by the method of ash analysis used, we refer to the sulphur analysis of pulp according to Klingstedt, the result of which agrees with those obtained from the ash, neglecting minor inaccuracies. According to this the lignosulphonic acid is not alone the carrier of cations (*9*).

The small amount of sulphate found in the ash, which is also present in the pulp, does not invalidate the above-mentioned finding.

A typical reaction is shown by magnesium. Here the exchange principle of pulp is most clearly seen. The magnesium content increases during the whole processing while the total ash decreases. Only the sum of CaO plus MgO is parallel to the SO_3 curve. The ratio of CaO to MgO in pulp (blow pit) is 20:1, but in the process water is 4:1. After the pulp has been in contact with water for about 4 hr., in the stage of filter E, the ratio of CaO to MgO has changed to 6:1. This tendency for the ratio of both of them in the pulp to approach that of the individual slushing medium can be traced throughout the whole process of production.

Following this the magnesium content of wood has little influence on conditions in the pulp.

In contrast, the major content of CaO in the wood is found in the pulp, exclusive of that which is bound to SO_3. We also carried out an analysis of iron, showing the results in Fig. 8 and Table II.

Table II

	Total ash, %	*Iron contained in % ash*	*Iron contained in % pulp*
Wood	0.24	0.350	0.000840
Blow pit	1.34	0.185	0.002483
Screening	0.96	0.323	0.003103
Thickening	0.90	0.323	0.002903
Filter A	0.87	0.287	0.002503
Filter E	0.53	0.221	0.001170
Chlorination	0.86	0.138	0.001190
Bleaching	2.06	0.080	0.001650
Acidifying	0.42	0.354	0.001490
Wet machine	0.48	0.312	0.001498

In the wood, which is the original material for the pulp in our analysis, an iron content of 0.35% of the ash was found at a total ash content of 0.24%, i.e., 0.000840% or 8.40 mg. per 1000 grams of moisture-free wood.

The pulp taken from the blow pit had an iron content of 0.185% of the ash, i.e., 0.00248% of the pulp, or 24.8 mg. Fe per 1000 grams moisture-free pulp. If all the iron contained in the wood remained in the pulp, only 76.8 mg. Fe per 1000 grams pulp would be obtained at an approximate yield of 50%. Consequently, it is proved that considerable iron has been added by the cooking acid. The latter showed an iron content of 3.10 mg. per liter. From the blow pit through screening the iron content curve shows a considerable increase. The increase might come partly from the process water or, on the other hand, through the corrosion of the iron parts of the screens. Water as the source need not be considered here as proved by a

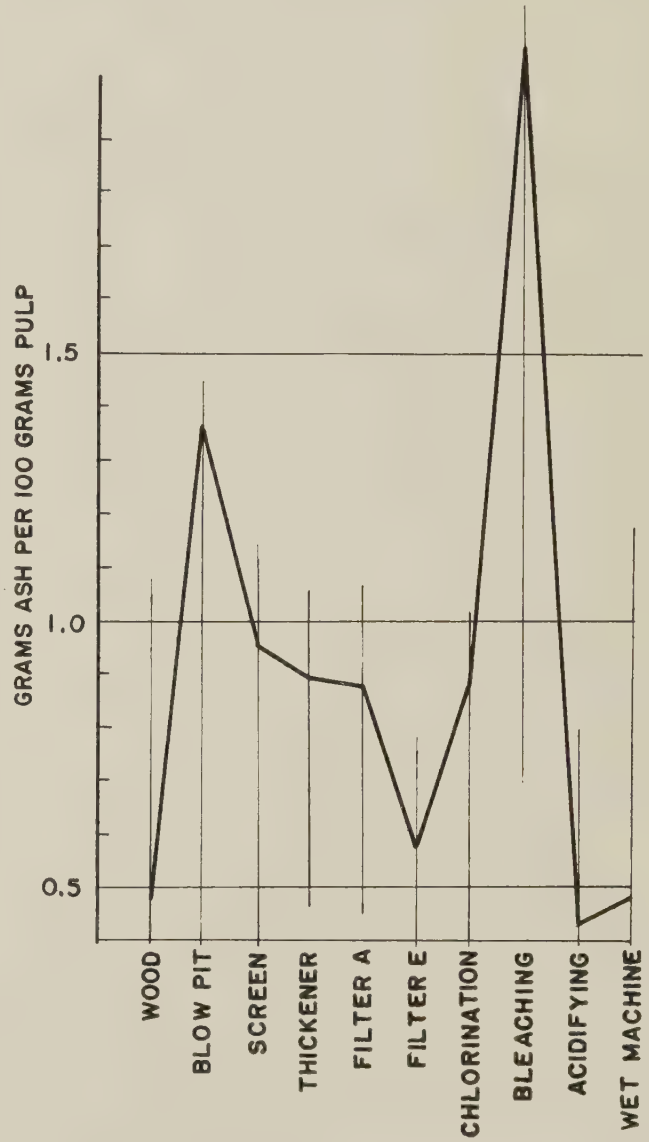

Fig. 2

washing experiment demonstrated in the laboratory in which conditions of productions were imitated. However, an inspection of the screen room would indicate an increase of iron content as likely, even without the aforementioned analytical results. A rough calculation indicates that at a given monthly production

* The flour stuff of the bleached pulp consists chiefly of fiber fragments.

of 2000 tons of pulp 1.488 tons of iron (or 0.186 cubic meters) will enter the pulp from the screens in the course of 10 years. The surface upon which such a corrosion will be possible would be approximately 150 square meters. Thus, according to this calculation, a layer of iron 1.24 mm. thick will be removed and absorbed by the pulp in 10 years.

In the further processing up to the treatment with bleach liquor, the iron content will decrease and will come to a minimum after passing through several washers. As the iron content in this stage determines the amount of the final iron content after the thickener, the question arises how far the corrosion iron will influence the minimum, whether a lower final iron content may be obtained at a lower degree of corrosion in the screening operation, or whether corrosion has not an important influence at this stage. The washing

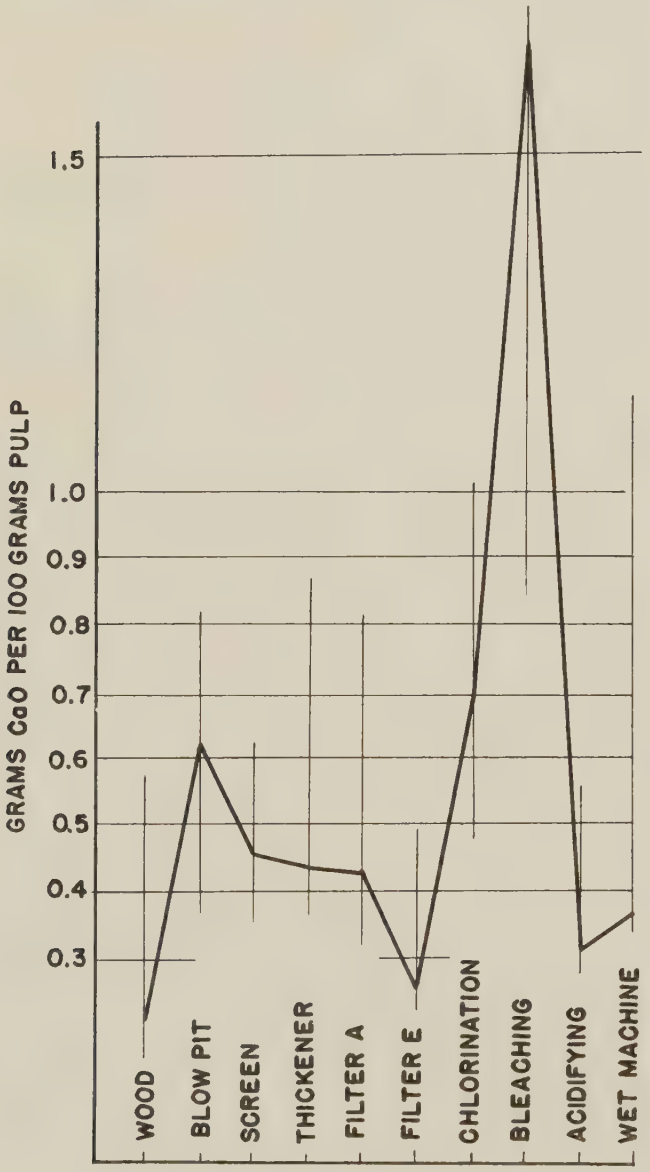

Fig. 3

experiments carried out in the laboratory are summarized in Table III. It follows that (1) the influence of corrosion iron is irrelevant in this stage, and (2) the sharp decrease in iron content after filtering is attributed to the removal of the short fibrous substances (flour stuff, ray cells).

The pulp absorbs 48.00 grams of the 59.36 grams of iron introduced into the slushed pulp with 21.2 cubic meters of bleach liquor which contains 0.28 mg. Fe per liter. The iron does not react in the same way as manganese which is not increased in the pulp by bleaching. The manganese is existent as manganate in

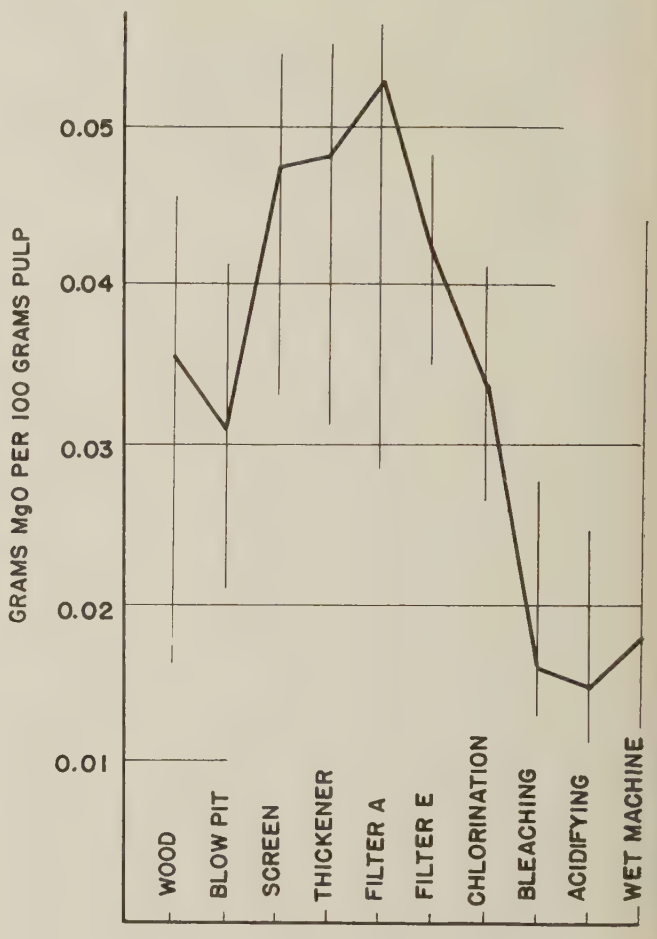

Fig. 4

the bleach liquor and passes over to permanganate at decreasing pH. The pulp cannot absorb it in the form of an anion, but the unstable ferrate passes over to the three-valence stage and will be precipitated on the fiber or adsorbed by the fiber as the colloidal hydroxide. By acidulation a reduction of the iron content as well as of all other ash constituents will take place. Because the tower acid contains 2.5 mg. Fe per liter its effect upon the iron content of the pulp will be reduced.

Table III

Treatment of pulp	*Iron content in mg./kg. starting with an initial weight of:* 24.8	31.0
After half an hour washing of the pulp with fresh water	20.9	22.0
After 3 hr. washing with fresh water	17.4	19.2
After 3 hr. washing with fresh water and intermediate removing of the flour-stuff (Klemm-Hurum)	7.3	7.7

The rise toward the end of the curve is due to small metal fragments from machine parts and rolls which adhere to the pulp during the last phase. A sheet of pulp impregnated with 0.1 *N* HCl will show these fragments very distinctly as dark red spots on a sheet of otherwise pale pink color provided that potassium sulphocyanate (10%) has been used.

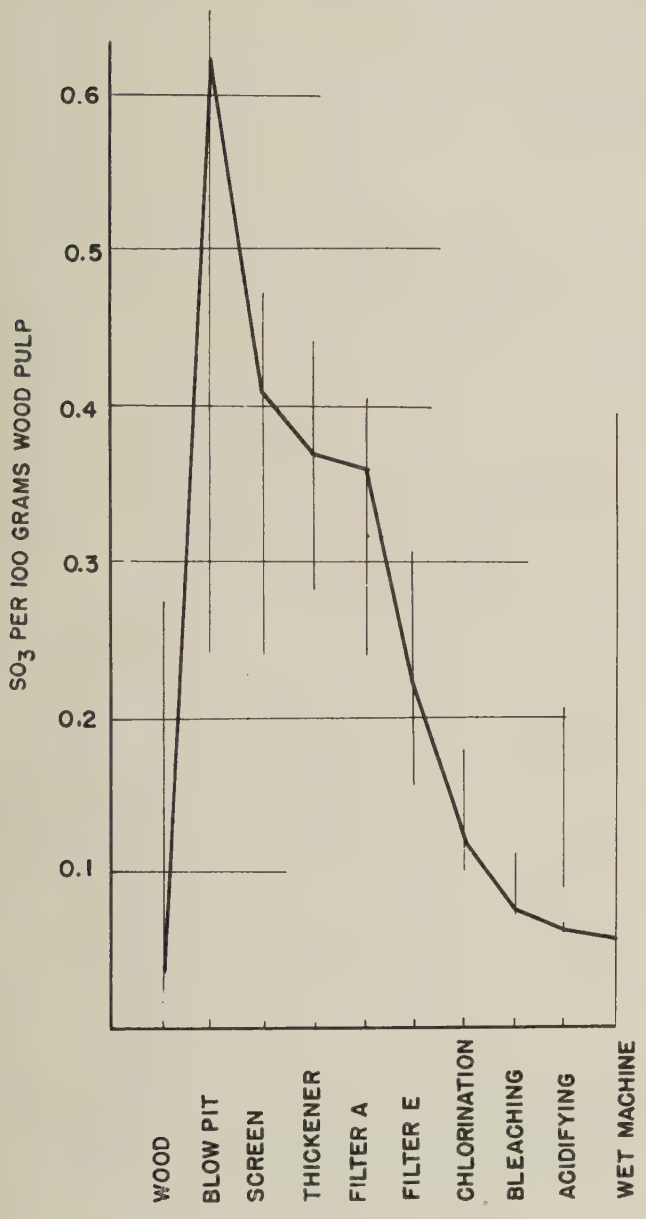

Fig. 5

By the above method a worth-while quantitative estimate can be made, after sufficient practice, which is adequate for ordinary operation conditions.

F. Wultsch has previously investigated manganese in the pulp (*2*). It is stated there that the manganese originates in the ray cells of the wood, and will be removed with them (the flour stuff of the unbleached pulp).

Thus the results as determined here confirm these statements, see Fig. 9, or Table IV. The extraordinary decrease in manganese in this phase is striking and is accompanied by a considerable loss of flour stock after long washing. However, the aforementioned results require further explanation. The definite exchange of ions shown very distinctly by the reaction of both calcium and magnesium indicates a relation of respective quantities in the pulp approaching those prevailing in

Table IV

	Total ash %	*Manganese in % of ash*	*Manganese in % pulp*
Wood	0.24	2.580	0.00621
Blow pit	1.34	0.087	0.00117
Screening	0.96	0.096	0.00092
Thickening	0.90	0.096	0.00086
Filter A	0.87	0.085	0.00074
Filter E	0.53	0.022	0.00012
Chlorination	0.86	0.011	0.00009
Bleaching	2.06	0.0035	0.000072
Acidifying	0.42	0.0015	0.000065
Wet machine	0.48	0.0013	0.000062

the water and cannot be confined to calcium and magnesium alone. All ions existing in the pulp and water participate in this exchange. The loss of flour stock is not to be held entirely responsible for the reduction of the manganese but also—and this determines the final manganese content—the low manganese content of the process water on the one hand and the calcium ions of the water on the other.

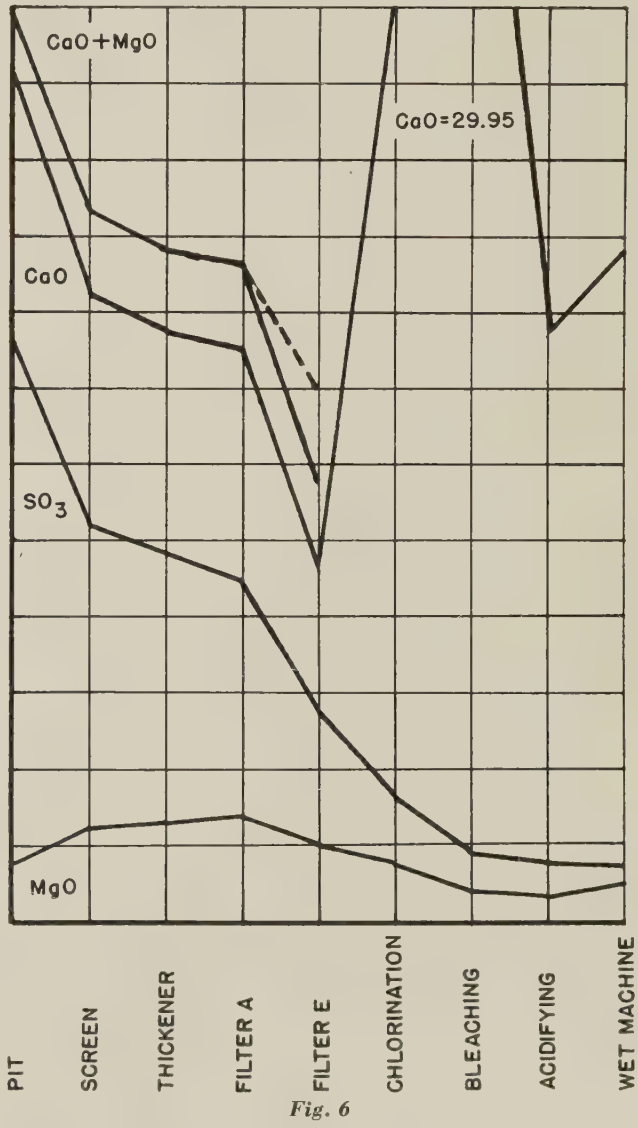

Fig. 6

From the above the interesting conclusion is that in

this phase of operation a highly diluted solution of salt (in the absence of heavy metal cations) in the process water is preferable to pure distilled water in the first step. The ideal water would thus be permutated (i.e., only containing sodium ions), but not distilled water.

Manganese becomes effective as a catalyzer during the preripening of the viscose process. Quantities up to 0.1 mg. per 100 grams of pulp are without influence, however, the unfavorable influence is measurable at 0.28 mg. per 100 grams and interferes with production (*2*).

The amount permissible in paper has not been accurately determined but good practice will require the removal of manganese from this pulp as completely as possible.

The reaction of copper during pulp processing is shown in Fig. 10 and Table V. The curve shows two

Table V

	Total ash, %	*Copper in % ash*	*Copper in % pulp*
Wood	0.24	0.200	0.00048
Blow pit	1.34	0.076	0.00102
Screening	0.96	0.121	0.00116
Thickening	0.90	0.111	0.00100
Filter A	0.87	0.058	0.00050
Filter E	0.53	0.043	0.00023
Chlorination	0.86	0.068	0.00030
Bleaching	2.06	0.041	0.00083
Acidifying	0.42	0.142	0.00060
Wet machine	0.48	0.115	0.00055

rising branches. The increase during screening may be explained similarly as in the case of iron. The H-ions still adhering to the fiber attack the existing screens and pipe lines made of copper and the H-ions will be exchanged for copper. Since the pulp will again come into contact with copper, without a resulting increase in the copper content, it may be assumed that after

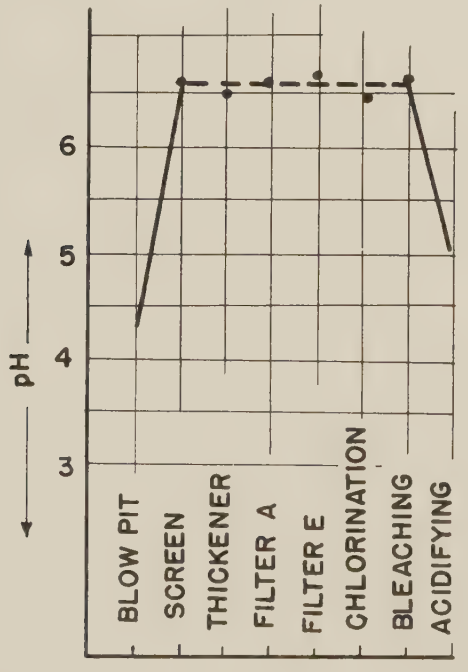

Fig. 7

thickening, the balance with other cations and the removal of the pulp flour predominates. The last increase occurs during bleaching.

Thus it is shown that the copper machine parts are much less of a source of copper than has been previously assumed.

Lead has not been found in the wood, and its presence (see Fig. 11, Table VI) must be solely laid to the lead content of the tower acid or cooking acid. During the whole course of processing the lead content continuously decreases. In contrast to all other metals a slight increase takes place in the acid stage.

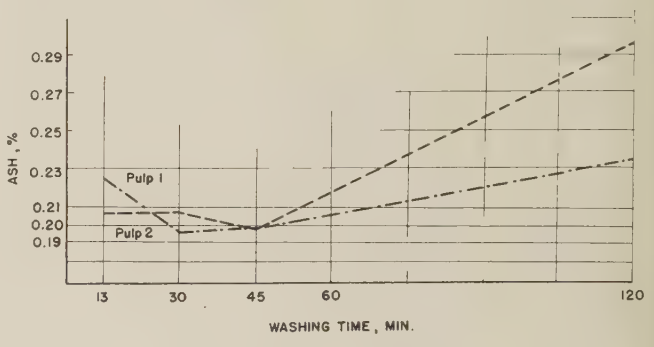

Fig. 7a

The reaction of silicon dioxide is shown in Fig. 12 and Table VII. It is shown that at filter A–filter E the greatest decrease takes place.

Table VI

	Total ash, %	*Lead in % ash*	*Lead in % pulp*
Wood	0.24	0.000	0.00000
Blow pit	1.34	0.022	0.000294
Screening	0.96	0.020	0.000187
Thickening	0.90	0.015	0.000135
Filter A	0.87	0.013	0.000120
Filter E	0.53	0.012	0.000062
Chlorination	0.86	0.006	0.000056
Bleaching	2.06	0.002	0.000052
Acidifying	0.42	0.016	0.000072
Wet machine	0.48	0.014	0.000071

In this study sand was also considered. Its proportion is, however, so small that increases and losses are not registered.

RESULTS AND DISCUSSION

The results, following the sequence of the experiments, demonstrate that the mechanics of reception and delivery of the ash formers during the pulp production is of a highly complex nature.

Table VII

	Total ash, %	*SiO_2 in % ash*	*SiO_2 in % pulp*
Wood	0.24	6.21	0.0149
Blow pit	1.34	2.56	0.0344
Screening	0.96	3.54	0.0340
Thickening	0.90	3.83	0.0334
Filter A	0.87	3.68	0.0334
Filter E	0.53	2.21	0.0117
Chlorination	0.86	1.38	0.0119
Bleaching	2.06	0.96	0.0198
Acidifying	0.42	4.40	0.0185
Wet machine	0.48	3.81	0.0182

From the blow pit through to the wet machine a change of ash capacity takes place. This change is caused by different types of reactions.

1. A purely mechanical reduction is caused by the

fact that stock portions containing more ash than the pulp on an average, owing to their high content in carboxyl groups, are removed together with the wash water (flour loss from filter A through to filter E).

2. However, chemical reactions are of much greater importance. The solution of sulphonic lignin occurring

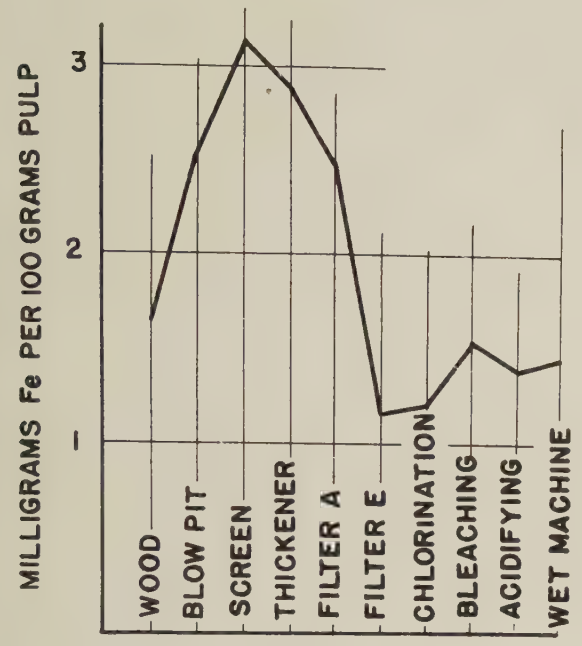

Fig. 8

during the pulp processing is part of these reactions. Under conditions during the digestion the latter is irrelevant, but later becomes a controlling factor with respect to ash, especially in the case of hard sulphite pulps with high lignin content.

The effect of bleaching upon the ash capacity will be different according to the kind of pulp and bleaching operation. However, two reactions will always be opposing each other: (1) the setting free of groups acting as ash carriers, such as the sulphonic acid group, effects a decrease in the ash capacity, while (2) the formation of new groups of carboxyl nature will increase the same.

In the present case in which a hard pulp with high lignin content has been subjected to intensive bleaching to obtain a definite whiteness, the second of the aforementioned reactions will be the stronger. Therefore a considerable increase in ash capacity will result.

Also changes take place within the ash capacity showing the proportional composition of ash in the individual stages. A comparison of these proportions will show

Table VIII

	Blow pit, g./100 g. pulp	*Waste Liquor, g./l.*	*Pulp Screen, g./100 g. pulp*	*Process Water, g./100 g pulp*
CaO	0.6323 (*a*)	1.0135 (*a'*)	0.2586 (*c*)	0.0727 (*c'*)
MgO	0.0312 (*b*)	0.0405 (*b'*)	0.0411 (*d*)	0.0188 (*d'*)

that a continuous tendency exists for balancing of the individual proportions in the fiber with the reciprocal ratios of concentration within the suspending medium.

Donnan's formula expresses these ratios very well:

$$\left[\frac{(Ca)f}{(Ca)w}\right]^2 = \left[\frac{(Mg)f}{(Mg)w}\right]^2 = \left[\frac{(Fe)f}{(Fe)w}\right]^3 = \left[\frac{(Mn)f}{(Mn)w}\right]^2 = \left[\frac{(Cu)f}{(Cu)w}\right]^2 = \cdots$$

This is particularly striking in the case of calcium and magnesium, as has been already mentioned. In Table VIII, the ash content of the pulp in the blow pit, filter E, and the inorganic residues of the respective suspending medium, such as waste liquor and process water are shown in their corresponding value. Thus

$$\frac{a:b \sim a':b'}{c:d \sim c':d'}$$

A quantitative determination and calculation according to Donnan's formula is not practical under the given conditions.

Apart from these exchange reactions, those relative to adsorption and precipitation are prominent. However, their importance is negligible exclusive of the bleaching stage in which they become noticeable in the case of iron and calcium. Furthermore, mineral substances are present in the pulp which are neither participating in exchange reactions nor being adsorbed or precipitated, but are still existing in the fiber structure originating from the wood. They consist of silicates, silicon, and perhaps resinates. They too are only a minor portion of the ash.

The origin of the individual ash portions in the finished pulp is shown in the respective figures. In general, it may be said that for the increases, the

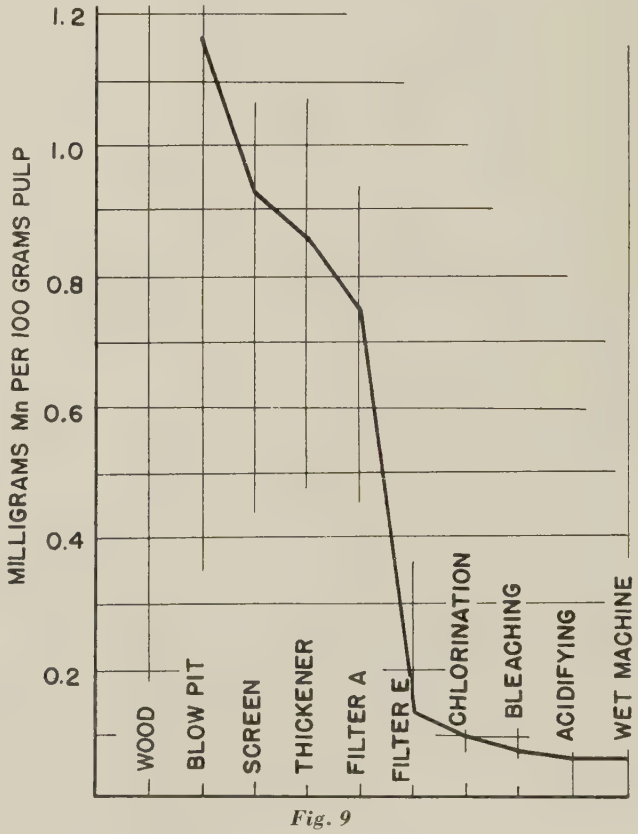

Fig. 9

solutions used for the digestion and bleaching, and the raw material, wood itself, are primarily responsible, and least of all, the plant and equipment. The process water, because of its content of the metal parts in question, controls at the "washing out" the lower limit of the proportion of same contained in the pulp.

POSSIBILITIES WITH REGARD TO "DE-ASHING"

To eliminate the sources of the detrimental ash portions it would necessitate continuous uneconomical expenditure, such as the use of purest chemicals and anticorrosive and acidproof equipment aside from the fact that some of these metals coming from the wood would still exist in the pulp. Thus only after-treatments of the pulp or such treatments as can be incorporated with the final stage during the normal course of production can be taken in consideration.

Certain deficiencies exist in the methods used to reduce the ash content in pulp mills by means of acidulation (exchange of metal-ion for H-ion and solution of the precipitate on the fiber). On the one hand, the pulp saturated with H-ions attacks the metal parts of the machine and is subject to destruction in the process of drying (*9*). On the other hand, while the total ash content will be reduced by means of acidulation, the removal of small amounts of existing metals will be unsatisfactory. But these are the very metals which cause considerable difficulties in pulp production. Naturally it would be possible, for instance to substitute completely another cation for the iron-ions, provided that

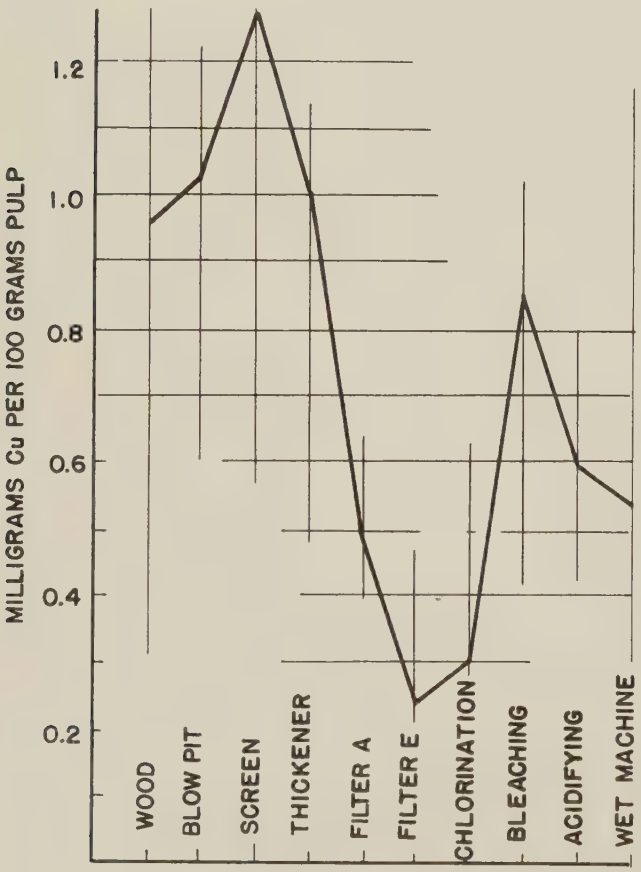

Fig. 10

there is no iron-ion present in the whole sphere of reaction. However, the normal process water which is available in large quantities will always contain iron.

Negative ions do not participate in the exchange reactions. Should we succeed in transforming the positive metal ions which are to be removed into negative ions by means of forming complex salts we would then have the possibility of carrying the desired exchange reaction to a final stage. Experiments carried out in this field have shown that this way is practicable.

ORDER OF EXPERIMENTS AND METHOD OF ANALYSIS

The above have been so arranged that samples were taken from each process stage, as mentioned before, so that each sample represented an average value of the

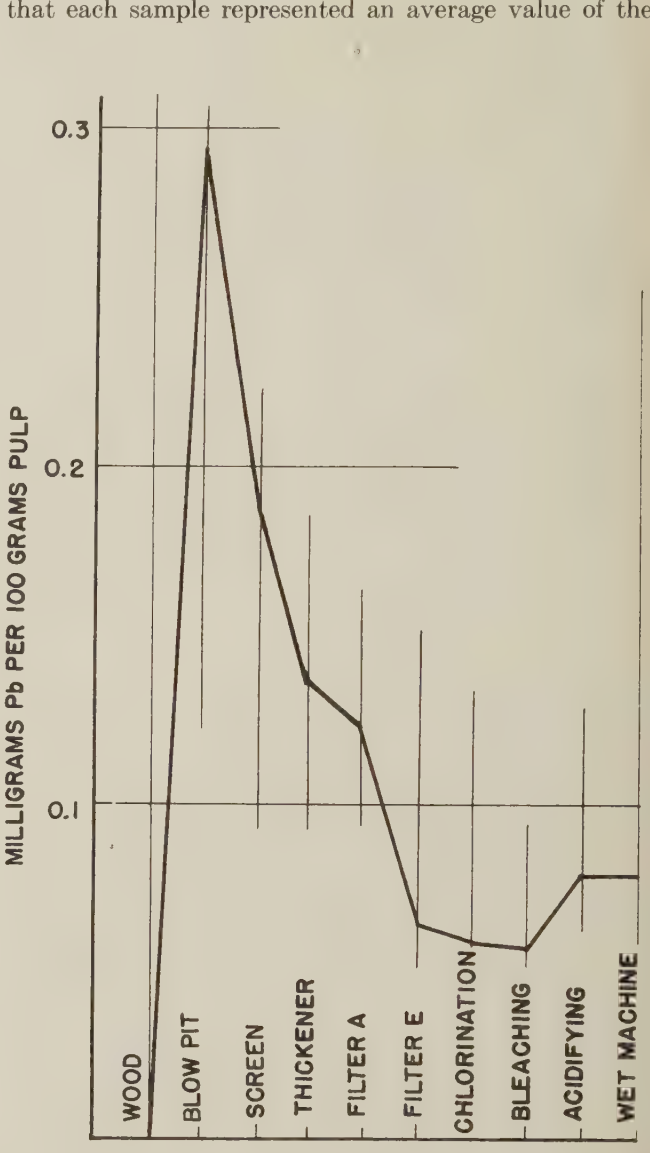

Fig. 11

particular stage being sampled. The samples obtained were dehydrated to 60% moisture and then dried. All figures thus obtained were based upon carefully determined averages.

The ashing was carried out at 350 to 400°C. under a continuous supply of air to eliminate any possibility of reduction. After ashing, hydrogen peroxide was added, carefully evaporated, and annealed at 800°C. until constant weight was attained which usually requires 30 to 40 min.

In this manner was obtained both the ash needed to determine the total ash content and the ash which served for analysis of the individual ash constituents. In all cases the analysis results were directly referred to the

total ash, which was separately determined, and later expressed in relation to the moisture-free pulp. In the case of copper and lead, the pulp was weighed and the metals calculated in relation to ash as no higher temperature than 400°C. may be applied because of their volatility. In the analysis of total ash the in-

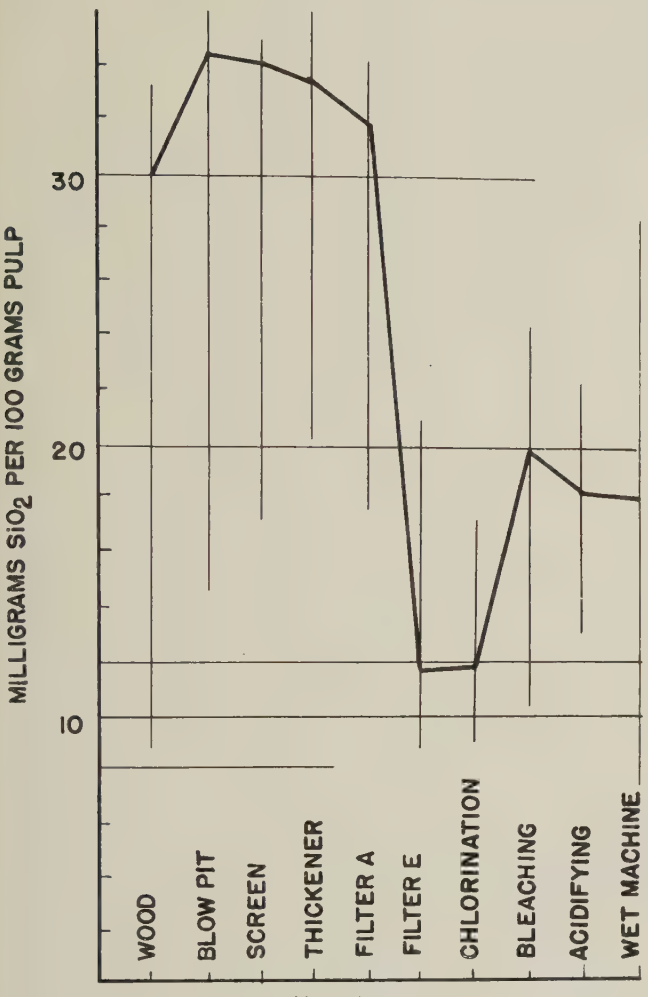

Fig. 12

significant amount of copper and lead is below the limit determinable and may thus be neglected.

The metals, such as iron, manganese, copper, and lead present as traces, but of interest, on account of their catalytic qualities were determined by colorimetric methods which first had to be worked out and modified.

Furthermore, great care was taken that this analysis was never carried out using a filtrate, such as after the precipitation of silica, the reason being the exchange nature of cellulose substances. Figure 13 shows how greatly a filtration containing minute amounts may influence and falsify the result. In the latter is shown the lead content of the filtrate as a function of the number of filtrations using regular quantitative filters.

Thus ash determined as stated above, was weighed directly to obtain the reported values, and in case of manganese and iron, was expressed in relation to pulp. In the case of copper and lead, pulp which was dried to constant weight was used because of the volatility of the two metals.

For the determination of iron we took into consideration one of the many well-known colorimetric methods, the oldest, but very sensitive ferrisulphocyanate method which, however, is subject to various side reactions. With respect to the way this color reaction takes place, and the factors which interfere, extensive literature is available (*14*). This question may be answered in different ways, but all analytic chemists accept the underlying assumption that the coloring is caused by the undissociated $Fe(CNS)_3$. Although the complex ion $Fe(CNS)_6$ may be carrier of the red color, nevertheless the possibilities following the equilibrium $[Fe \ldots] [CNS]^3/[Fe(CNS)_3]$ which lead to a reduction of the coloring will be of importance thus: (1) reduction of the H-ion concentration and in consequence hydrolysis to $Fe(OH)_3$ and HCNS, (2) formation of more stable sulphocyanate complexes, (3) formation of more stable iron complexes, and (4) reduction caused by light.

In view of the above which could lead to false conclusions, and giving consideration to the findings of different authors (*14*, *15*), and after our own testing of the iron content of ash by the sulphocyanate method with the help of the reaction according to Zimmermann-Reinhardt, we found the following simple procedure leading to sufficiently accurate results, especially in the case of pulp ash.

Depending on the iron content, 0.05 to 0.2 gram of ash constantly annealed was weighed, then closed up with a small quantity of conc. H_2SO_4 + HNO_3 mixture, and filled up exactly to 50 ml. with 8% H_2SO_4. This solution was mixed with 5 ml. 10 *N* KCNS solution, and at once colorimetrically analyzed. For all colorimetric analyses the light-electric colorimeter by B. Lange was used to exclude sources of error and in-

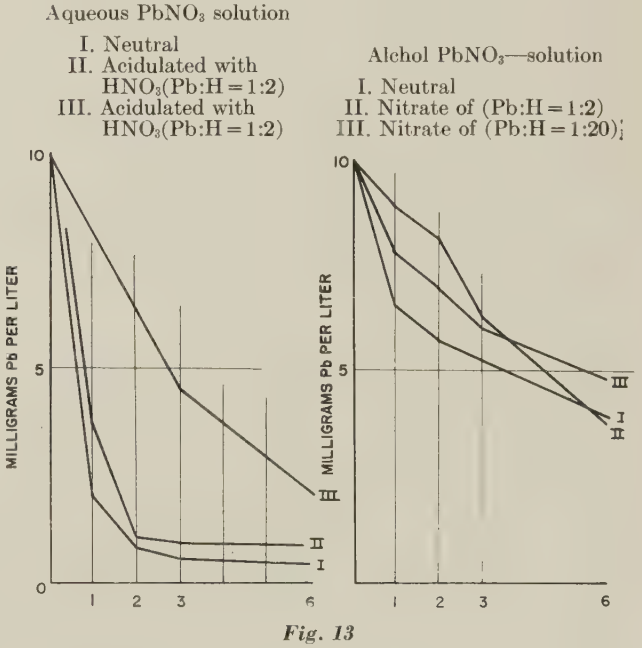

Fig. 13

accuracies conditioned by the physiological properties of the eye. The place of the eye is taken here by selenium photocells of half conductivity which deliver a sufficient amount of current to operate a normal pointer galvanometer. A calibration curve was worked out.

As a basis for the manganese analysis the method of

Marshall was chosen. The procedure as stated by R. Sieber was not satisfactory since the coloring developed with a weight of 5 to 10 grams pulp, as called for, is so weak that a quantitative determination is impossible. With higher amounts of ash, however, the chlorine content appears troublesome and moreover, the treatment as outlined is not always practical.

Corresponding to the approximate content of manganese, 0.2 to 2 grams of ash (i.e., 50 to 100 grams of pulp), were weighed out, then treated with a mixture of nitrosulphuric acid, and after removal of the chlorine ion which is absorbed in diluted nitric acid, it was further treated by the Marshall method.

In order to obtain an evaluation which is independent of the subjective eye's point of view, experiments were made to determine the permanganate volumetrically by means of an arsenite solution. However, the values thus obtained are not at all satisfactory on account of the fading end point. Thus we resorted, as in the case of iron to B. Lange's light-electric colorimeter. A calibration curve was made.

After the determination of the manganese content had been satisfactorily worked out in the manner described, an essay by Th. Kleinert and W. Wincor was published with the following title: "On the Analysis of Manganese in Pulp" (*16*). According to the instructions stated here, in which decomposition of the ash with bisulphate is essential, corresponding results have been obtained. In addition, however, the chlorine ion had to be removed.

The determination of copper and lead was more difficult. In almost all direct colorimetric methods the presence of other negative ions such as lead, copper, iron, and manganese will give a troublesome effect upon the reaction. For instance, a precipitation of iron with ammonia attracts copper by adsorption. Moreover, filtrate should not be used. Thus a method had to be developed by which copper or lead, respectively, could be determined directly in the dissolved ash. Such a method was found in the form of electrolysis, where copper and lead could be separated simultaneously. Thus greater scope was given to the selection of the following colorimetric determination. For greater simplicity, being applicable both to lead and copper, both were colorimetrically analyzed as colloidal sulphides.

In order to prove the accuracy of the electrolysis, solutions were electrolyzed corresponding to the composition expected to be found in the ash. It was shown that under normal conditions (voltage: from lead accumulator, room temperature, duration: overnight), lead was determined up to 90%, and copper from 65 up to 80% at best. Rapid electrolysis at 85°C. and using a propeller did not give better results. The error was caused on the one hand by varying voltage (decline), on the other hand by the treatment of the electrode after the electrolysis—in the wash water copper could be identified. Also a small content of nitric oxide gas prevents the complete precipitation of the copper.

In order to be able to work with a constant voltage, the net voltage was transformed from 220 to 8 v., and rectified and buffered by a lead battery. Thus an exact constant voltage of 2.0 v. could be obtained for an unlimited period.

The method described below was deemed suitable. The pulp (20 to 40 grams) which may be either moisture-free or air-dry with a simultaneous water content determination, is saturated, after weighing, in a quartz dish with diluted nitric acid, dried, then impregnated with conc. nitric acid, evaporated, and at once heated to ashing temperature of 400°C. and kept at this temperature until ashing is completed, which takes maximum of 6 hr. Great care must be taken that the whole pulp is exposed to the heat since dry distilled tar products condense at colder points which are not submerged and afterwards cannot be volatilized or burnt. Should the ashing be incomplete in the stated time, the test must be discarded. The almost white ash is next vaporized with half conc. hydrochloric acid. After removing all free hydrochloric acid the ash is dissolved in 5% nitric acid, heated to release all nitric gases, and electrolyzed after cooling. The spiral is the cathode and the net is the anode. After about 12 hr. the precipitation, which may be controlled both by the electrodes and the solution, is completed.

The copper or lead dioxide, respectively, on the electrode is dissolved with dilute nitric acid. Nitrite has to be applied in the event that there is lead dioxide which is to be vaporized.

The solutions thus prepared are made weakly ammoniacal, acidulated with acetic acid, and are treated with a drop of sodium sulphide, which is stabilized with glycerine (10 grams $Na_2S \cdot 9H_2O$ dissolved in 40 ml. water and glycerine added to 100 ml.). The copper or lead, respectively, is precipitated as colloidal sulphide. Solutions which contained 0.10 mg. of the metal are used for comparison. The light-electric colorimeter was also used.

Calibration curves were made for both lead and copper.

The remaining ash constituents were determined in the usual method of analysis. Silicon dioxide was determined after a soda decomposition of the ash making it insoluble. In the filtrate calcium and magnesium were separated by the oxalate process and calcium was titrated, and magnesium gravimetrically analyzed. The sulphur was precipitated as barium sulphate.

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A Comparison of the TAPPI-SFMC Drainage Time Test Procedure with Other Methods

DAVID R. P. HAIG

A study is made of the test procedures of three different methods for measuring drainage time of insulating board pulps. Comparisons are drawn in terms of sensitivity to "free" pulps, simplicity of operation, reproducibility of results, and the effect of uncontrollable variables. The TAPPI-SFMC drainage time tester (T 1002) is compared to the "modified Green" and the British sheet machine used in T 221 m-50. Conclusions point out the merits of the SFMC tester as being anticipated since the apparatus was designed specifically for coarse, fiberboard stocks. Other methods, adapted from papermaking procedures, understandably fall short of full satisfaction.

THE comparatively infant insulating board industry can be thought of as a natural outgrowth of the comparatively ancient art of papermaking. As would be expected, many of the tools of the papermaker were found to be readily adaptable to the similar function of board forming. The largest single discrepancy perhaps was found in the marked difference in forming behavior necessitated by the radical increase in sheet thickness and fiber size. The acceptance of higher forming consistencies plus greatly reduced forming speeds adequately compensated for the thickness increase. Both these factors would still have not sufficed if the drainage time of the fiber furnish remained in the category of normal paper pulps. The coarse, more bulky fibers requisite for the structural strength and insulating property desired in the dried board also provided a furnish with a very fast (in paper terms) drainage time.

Existing freeness or drainage time testers, adapted from the paper industry, were satisfactory from the standpoint of the papermaker and his "slow" pulps. Adequate differentiation between stages of pulp treatment could be obtained through the entire phase of pulp preparation from beater to headbox. Such testers to name a few still being used satisfactorily today, are the Williams, the Schopper-Riegler, the Canadian Standard, and the British sheet machine.

The suspicion that a modification or revision of the existing machines might be required so that the faster pulps of the board industry might be better studied was aggravated by the realization that on a machine which had a water-zero reading of 3.5 sec., the influence of screen resistance, water friction, and water temperature changed from a negligible value (in the case of 200-sec. paper pulp) to one of considerable import with a groundwood pulp, of say, a drainage time of 12.0 sec. In addition, it was felt that the existing testers called for a test procedure which lacked the optimum simplicity held desirable especially in terms of a mill control method. Accordingly, the development of the T 1002 tester was undertaken by the Structural Fibrous Materials Committee to provide the following: (1) a simpler, more rapid tester, (2) a tester specifically designed for freely draining pulps (a minimum zero-reading), and (3) a tester which, though inherently sufficiently precise for laboratory use, could be utilized dependably in mill control.

We believe that our preliminary results obtained from both mill and laboratory experience show that the design objective has been realized.

COMPARISON WITH MODIFIED GREEN TESTER

The testers considered for comparison with the T 1002 all fall into two general types:

1. The first type is one which depends upon the measurement of water overflow volume determined by the rate of flow of water filtering through a screen from a given volume of stock. A specific restriction realized by the diameter of an outlet orifice in the collecting funnel causes an "overflow" volume from the initial surge of drainage to be collected via a side outlet, said volume being less for a slow-filtering sample than for a fast-filtering stock. The so-called "modified Green" tester presently used satisfactorily by at least one board manufacturer falls into this category of tester as does the familiar Canadian Standard and the Schopper-Riegler. Much of the discussion following, while directed mainly to the performance of the modified Green, is therefore applicable to any tester of the same type.

2. The second type of tester is one that depends upon the measurement of the time required for a given volume of water to drain from a container of stock at a definite consistency through a screened-bottom and is illustrated by the well-known Williams tester. The adaptation of the accepted sheetmaking equipment specified in TAPPI Standard T 205-m to the function of measuring drainage time concurrently with sheet forming also illustrates the method of measuring the time a measured volume takes to drain. Hereafter alluded to as the British sheet machine method, this procedure is that recommended in T 221 m-50, "Drainage Time and Drainage Factor of Pulp."

Operation

In operating the modified Green tester, it is recommended that 4 liters of agitated, temperature-adjusted stock (containing 20 grams moisture-free fiber) be introduced to the body of the tester which has the screen side down and the bottom lid closed. The top lid is then closed and the bottom lid opened. The uncovering of a small air-inlet hole in the top lid permits the water in the body of the tester to drop into a funnel mounted immediately below. The overflow from the initial surge of drainage is caught and measured in a

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graduate. As is evident from the above procedure, the test might well be designated as a "modified Canadian Standard" rather than a "modified Green." The reason for the latter title is that the dimensions of the tester body more closely resemble those of the cylinder used in the Green continuous freeness recorder and, in fact, provide four times the stock capacity of the Canadian Standard instrument. The increase in volume serves to enhance the sensitivity of the tester to pulps in the "free" or fast-draining range insofar as sharper differentiation is concerned.

Discussion

Unlike the TAPPI-SFMC T-1002 tester, the body of the modified Green is, in essence, an opaque (brass) cylinder. It has been determined (*1*) that any swirling of the stock during drainage has the effect of increasing drainage time. A convenience of the T 1002 tester *not* enjoyed by the modified Green lies in the transparency of the plastic tube which permits a definite check on the presence or absence of swirling. The assumption that the pulp is laid down in an even layer on the screen remains an assumption in the case of the latter tester while in the T 1002 its validity can be checked by observation.

This desirable visibility of the stock while under test also permits a check on the uniformity of the pulp suspension during the time of the test. Any deviation from uniformity such as settling-out or flotation is known to have an effect upon the drainage time.

A second point of interest common to the two testers lies in the weight of pulp used per test. Experience indicates that while uniformity of suspension is usually more easily obtained and held in a low consistency stock, the problem of swirling is aggravated. Although the Green procedure calls for 20 grams moisture-free pulp against 10.6 grams in the T 1002, the end concentrations are almost similar, i.e., 4000 ml. of water are used in the former to yield a consistency of 0.50% and 1800 ml. in the T 1002 to give 0.59%. The disadvantage of a low consistency (swirling) stock for drainage testing is more than offset by the theory (*2*). that the *higher* the consistency of the test stock, the greater the influence of flocculation which in turn results in a nonuniform pulp suspension and a nonuniform formation of the mat. Thus, both the modified Green and the T 1002, calling for a constant, low consistency test stock, are to be preferred to procedures which recommend that the consistency be varied arbitrarily at will—especially to encompass free-draining pulps. This similarity in consistencies helps to explain why a fairly good agreement is attained in pulp differentiation between these two testers when tested on identical pulps (*3*) over a range from "free" to "slow." The discussion above, relative to the advantages of being able to view the pulp suspension during test plus the fact that in the TAPPI-1002 a major concentration of resistance to water flow at the fiber pad under test (3-in. diameter screen versus 4-in. in modified Green) favors a better differentiation, would both tend to favor the smaller tester.

A comparison perhaps worthy of mention here is the drainage forces of both testers. The modified Green, as do all the others in the "overflow" category, depends solely on the gravity force of the head of stock contained in the body of the tester. As flow originates, this head is largely used up in overcoming an increasing resistance to water passage caused by the build-up of pulp on the screen. The variance in overflow volumes collected, therefore, is directly traced to a variance in the kinetic heads remaining in the outgoing water. The question arises whether such an index to the resistance of a layer of stock to the passage of water is in close enough accord with the behavior of the same stock when subjected to the much greater and more positive drainage force of a suction box or wheel. It has been determined (*4*) that the character of the layer of stock laid down under varying average heads of stock is considerably different and said character has a definite influence on the results obtained. For example, the layer of pulp laid down under a comparatively low head of water is rather diffuse while one collected under a greater head is understandably more dense purely by virtue of the velocity of flow. It is suggested that the latter condition more closely approximates the machine formation and the T 1002 tester was designed with sufficient head (obtained by a water leg below the screen) to at least approach actual forming conditions.

One advantage common to both the modified Green and the T 1002 testers is the convenience inherent in obtaining directly and immediately their index to the drainage behavior of a pulp without the necessity of resorting to the use of empirical formulas and tables with additional calculations. This benefit is of real value particularly in terms of mill control.

COMPARISON WITH BRITISH SHEET MACHINE METHOD

Operation

Described in T 221 m-50, an alternate method for determining a measure of the slowness of stock is recommended as a replacement for a conventional drainage time test. The equipment used is the same as that specified in T 205-m for sheetmaking and it is pointed out that a standard drainage time can be obtained at the same time the standard sheet is formed merely by measuring the time required to form a sheet at 20°C. weighing 60 grams per square meter (moisture-free). That this recommendation is obviously suitable only for paper pulps is evident when the test pad (200 sq. cm.) weight is calculated as 1.2 grams. In terms of insulating board pulps, such a pad weight would be unrecognizable as a sheet, and the time required to drain the water from such a consistency stock would be impossibly close to the water-zero of the machine which is given as 3.5 sec. Accordingly, recognizing this fact, the procedure offers an alternate index to "drainage *time*" for very "free" pulps and describes it as a "drainage *factor*." It is defined as "the drainage time in seconds per gram of pulp" and can be "applied satisfactorily to both very free and very slow pulps." Mentioned in the discussion as a "substantial" quantity of pulp being required for very free pulps, the weight of "30 grams or more" is offered as being necessary for each determination of the drainage factor.

Discussion

Going back to the influence of test stock consistency upon the drainage time discussed in relation to the modified Green tester, it is suggested that a procedure

wherein such an undesirable variable is introduced is subject to question. At pulp weights much beyond the 30 grams mentioned, the concentration would be very definitely in the range wherein flocculation and nonuniform suspensions become definite factors in influencing drainage times. At this point it could be brought out that in relation to the two factors just mentioned, flocculation and suspension, the sheet machine suffers from the same disadvantage that the modified Green does, that is, the opacity of the tester body. Unlike the T 1002 tester, the stock cannot be observed during test. Therefore, the questionable assumptions necessary in any nonvisible draining test are again in force with the sheet machine, that is: (1) pulp is substantially air-free, (2) no swirling of stock, and (3) uniform pulp suspension (no flocculation, settling, or creaming). Under some circumstances any or all of the noted conditions can have serious effects on the results of the test.

The procedure outlined for determining the drainage factor of a given pulp is, in brief, the ascertaining of the respective drainage times of two different weights of the same pulp (at two necessarily different consistencies) and, by calculation involving empirical formulas, the slope of the line of drainage time versus sheet weight is determined. This slope is the drainage factor for that particular pulp. While this procedure is offered as being a satisfactory substitute for the drainage time index used for the slow paper pulps, it is difficult to see how a justifiable correlation between the two can be drawn when a factor as important as stock consistency is introduced as a variable. Further, a recommended "modified" method for determining the drainage factor (adaptable for "mill control or routine purposes") relies on an extrapolation of a line drawn tangentially to a curve resulting from a plot of drainage time versus sheet weight. There is evidence to indicate that such a plot does not provide a legitimate extrapolation in the case of very free pulps since it appears as a straight line to the zero-reading of a machine. In the case of slower-draining pulps, the plot does begin to show a curvature, but the T 221 m-50 procedure applies the extrapolation theory to both free and slow.

The drainage force of the British sheet machine, like the T 1002, depends not on gravity alone but has the more positive suction provided for by a water leg below the screen. As mentioned in the discussion above relative to the modified Green tester, such a draining action is thought to be more closely related to the forming action of a suction box, resulting in a more dense test sheet. A point of possible variance, however, eliminated in the design of the T 1002 tester, lies in the end point of the measured drainage time. The recommendation of T 221 m-50 is to "Stop the watch as soon as the water *leaves the wire*." In the case of a very thin sheet such as would be obtained with conventional paper pulps it might probably be safe enough to assume that point wherein the sheet flashes dry to be the same instant in which "the water leaves the *wire*." In the case of the comparatively thick pad resulting from the more bulky, practically noncompressible insulating board pulps, however, the *wire* may well be a considerable distance below (and therefore not visible) the top of the sheet or pad. The recommendation to test two sheets of different weight (and therefore different thicknesses) further complicates the precision of the end-point determination. Since the precision requested for report in the T 221 m-50 extends to 0.1 sec., it is suggested that the end point for timing is too obscure. In the T 1002 tester, end-point uncertainty has been eliminated by the choice of a volume level well above the top surface of the test pad. In this design, the operator's watch is stopped for the end of the test when the level of stock passes the lower of two lines scored on the transparent plastic body of the tester. Drainage continues to the point where the test pad is "dry" but merely as a check on the maintenance of the suction leg and, incidentally, to facilitate removal and handling of the tested pulp.

VARIABLES AFFECTING THE T 1002 TESTER

In laboratory work with experimental furnishes, many of the known variables affecting drainage time can be eliminated or controlled by precision methods. For mill control, however, much of the stock available for required testing will not conform to the standards which are routine in laboratory preparation. To investigate the effect of some of these variables upon the drainage time using the T 1002 tester, a series of examinations were made upon two types of pulp. One type, hereafter called a "fast," mechanical pulp can be said to fall about midway in the range of insulating board furnishes. The second type, called a "slow," chemical pulp is not normally encountered in board forming since its drainage characteristics are such as to place it in the lower range of paper pulps.

Figure 1 illustrates the relationship between drainage time and pad weight of both the "fast" and "slow" pulps. The straight-line relationship mentioned previously as existing for free-draining pulps appears to change to a nonlinear one as the slower range of pulps is tested. In collecting these test data, to avoid or minimize a potentially serious variable, one operator performed all the testing on both types of pulp. Every precaution was taken to ensure that other known variables such as stock temperature and pH were held constant. Observations of pulp suspensions during test confirmed the importance of consistency in relation to flocculation tendencies at the highest density and swirling aggravation at the lowest. Both were carefully avoided.

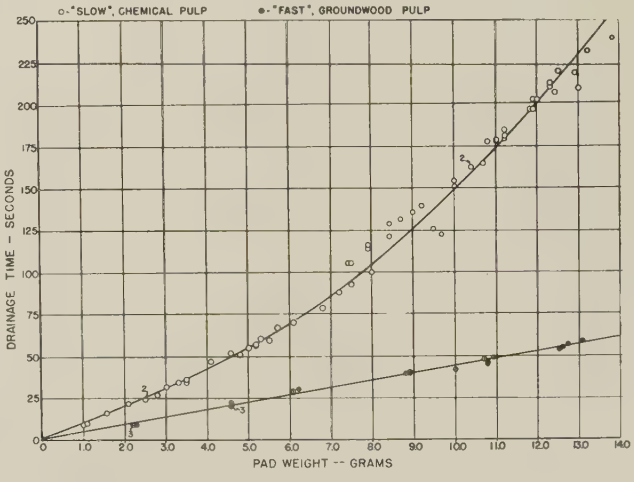

Fig. 1. Plot of pad weight versus drainage time using the TAPPI SFMC drainage time tester

The straight-line ratio for a given pulp provides a real convenience in terms of using the T 1002 as a mill control instrument since errors in sampling consistencies may be quickly corrected to a standard pad weight without calculation—merely a one point plot back to the known zero of the instrument.

Drainage Time—pH Relationship

Shown in Fig. 2 is the relationship between the drainage time and the stock pH. This variable can be of considerable import in the board mill since the drainage time of pulp is often of interest at several points in the flow line of stock preparation. Of particular interest, of course, is the drainage behavior of the stock in the range of pH normally encountered or desired in the actual board forming. It can be seen that, again, the two types of pulp behave differently as the stock pH is varied. The "free" pulp data indicate that little or no change in drainage time is effected by a pH variance over the range from 4.0 to 10.0 The "slow" fiber, on the other hand, indicates that an increase in pH over the same range has a definite slowing action on the drainage time. No attempt is made in this paper to explain this behavior other than a suggestion that the softer fiber is more vulnerable to a further softening action at the higher pH values. Softer, more compressible components are known to have a definite effect on the specific resistance of a pulp (*2*) and thus, a definite reflection in drainage time. In testing for these data, one operator conducted all the tests and the test stock temperature was closely controlled. Test consistencies were precisely controlled to yield constant test pad weights. It can be seen that the effect of pH over the range of values normally encountered in board forming can be considered negligible.

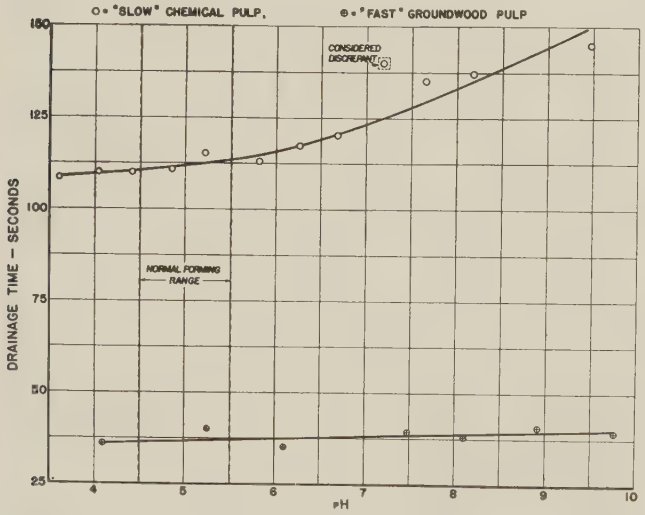

Fig. 2. The effect of a varying slurry pH upon the drainage time of wood pulp using the TAPPI SFMC tester

In the investigation of the effect of stock temperature versus drainage time, the results of which are shown in Fig. 3, no attempt was made to allow for any softening effect on the pulp itself as the temperature was increased. The primary effect on drainage time has been fairly conclusively shown to be the change in fluidity of the water (*1*) and, as the curve shows, said effect is not too marked within the range of 80 ± 5°F. which is recommended for the T 1002 procedure. Accordingly, if the tolerances suggested are adhered to in mill control work, no temperature correction need be invoked. Precautions as to control of other variables were taken throughout the testing, including the same operator for all tests.

CONCLUSIONS

Compared with the "modified Green" drainage time tester, the T 1002 offers the following advantages: (1) less stock required per test (10.6 grams versus 20 grams), (2) a more positive drainage force, (3) pulp

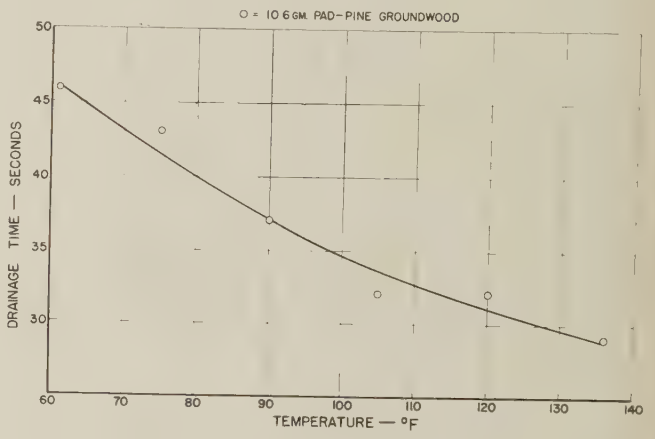

Fig. 3. The effect of stock temperature upon the drainage time of wood pulp using the TAPPI SFMC tester

suspension visible throughout the test, and (4) a major concentration of resistance to water flow at the fiber pad under test (3 in. diameter versus 4 in.).

The comparative reproducibility of results and simplicity of operation have been evaluated on identical test pulps and are similar enough to be considered equal.

Compared with the British sheet machine (T 221 m-50) method the T 1002 offers a desirable, single-test index whereas the former requires a two-point determination (in the case of the "free" pulps under consideration) plus empirical calculations to arrive at a drainage *factor* rather than a drainage *time*. The factor, obtained from drainage times of the same pulp under different conditions of test (consistencies) is suspect in terms of a legitimate correlation with other drainage data on other pulps obtained under standard conditions.

As in the case of the modified Green, the British sheet machine method does not have the following benefits possessed by the T 1002: (1) less stock per test (10.6 grams versus >30 grams), (2) pulp suspension visible throughout the test, (3) a major concentration of resistance to water flow at the fiber pad under test (3 in. diameter versus 8.6 in.) and (4) end point of test unmistakably defined (not a factor in the Green).

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The Impermeabilization of the Lagoon at the International Paper Co., Chisholm, Me.

T. WILLIAM LAMBE and OSCAR E. ANDERSON

This paper describes the successful impermeabilization of the sulphite liquor storage lagoon of the International Paper Co.'s Otis mill at Chisholm, Me. The impermeabilization was accomplished by the controlled construction of a chemically treated soil blanket. Use of a trace amount of a dispersant resulted in a 1-ft. thick soil blanket with the sealing capacity of a blanket of untreated soil about 10 ft. thick. The chemically treated blanket cost about 10% more than an untreated soil blanket of the same thickness. Field measurements of lagoon leakage and piezometric head show the performance of the blanket to be excellent. Experience with the Otis lagoon proves that, where suitable soil is available and where proper techniques are employed, an economical and impermeable blanket can be built of chemically treated soil.

In 1948 a lagoon was constructed at the International Paper Co.'s mill, Chisholm, Me. Across the Androscoggin River and upstream from the mill, the lagoon is located in the town of Jay. The lagoon was built to store sulphite waste liquor (2 to 4% solids) during the warm, dry, Summer months when the discharge of this liquor into the Androscoggin, when combined with domestic sewerage and the effluent from two mills upstream, caused too large a reduction of dissolved oxygen in the river, as well as an objectionable odor downstream. The stored liquor in the lagoon was then dumped into the river during the late Fall and early Winter when the river's flow was large enough and temperature low enough to handle the liquor. The regulation of the rate of liquor discharge into the river was under the supervision of W. A. Lawrance, Court-appointed River Master.

The lagoon site had, at one time, been provided with a dam and used as an ice pond. On the foundation of this old dam, an 8-in. concrete core wall was built and supported on both sides by the sandy soil excavated for the lagoon. The lagoon, covers an area of 6.4 acres, has a maximum depth of 20 ft. and a capacity of 22 million gal. The steepest slope of the soil banks is about 4 horizontal to 1 vertical. At its nearest point, the lagoon is 250 ft. from the river. The soils underlying the lagoon and between the lagoon and the river are water-deposited glacial gravels and sands.

Studies of percolation in test holes prior to construction indicated the lagoon could be sealed with groundwood white water from the mill. Sealing with the white water was, however, not successful because shrinkage and resulting cracking of the pulp on drying were excessive. The dry pulp was also blown around by the strong winds at the site.

Various attempts during the Summer of 1948 to seal the lagoon floor were equally unsuccessful. In 1948 the liquor first reached the river in late Fall. Each year since 1948, the liquor reached the river at an increasingly early date, (see Table II), until in 1952, the situation became alarming. Predictions indicated that before long too much of the liquor would reach the river before the critical warm period had passed. The decision was made, therefore, to impermeabilize the lagoon with a blanket.

BLANKET DESIGN

Type of Blanket

There are many techniques used to reduce the permeability of soil. To impermeabilize strata below the ground surface, four general types of fluids have been injected: (1) chemicals—silicates, polymers, etc.; (2) cement-water suspensions; (3) bituminous materials; and (4) clay-water suspensions. The complicated construction techniques required for injection justify the use of fairly expensive grouts. The high cost of injection makes it a procedure that is not usually employed if a surface impermeabilization, such as a blanket, is possible.

Portland cement (reinforced concrete, unreinforced concrete, gunite, shotcrete, etc.), bitumen (asphaltic concrete and exposed and buried asphaltic membranes) and soil (swelling minerals, compacted earth, soil stabilized with bitumen, chemicals, portland cement, and other materials) have been used to line canals and reservoirs.* Impregnated fibers (*4*) and cement plant cottrell dust (*5*) have recently been studied as lining materials.

Whether used to line a canal or reservoir, the blanket material must, of course, sufficiently reduce seepage losses. The stability requirements are, however, much greater for a canal liner than a reservoir blanket. A canal liner must be able to withstand the eroding effects of flowing liquid, and the deteriorating effects of wet-dry and freeze-thaw (for cold climates) cycles. These destructive agents are not important for small reservoirs (small enough for wave action to be negligible) which are kept filled.

The disadvantage of soil for lining, compared to some of the other materials, is its relatively low erosion and weather resistance. As pointed out, this can be a major drawback to the use of compacted earth in canals but may be of no importance in reservoirs. A protec-

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* The uses of some of these materials are discussed in references (*1, 3, 6, 7*).

tive cover—gravel, rip-rap, etc.—can make the use of compacted soil feasible even for canal liners, as its extensive use by the Bureau of Reclamation (7) proves.

Compacted soil, on the other hand, possesses several major advantages over other blanket materials. It has

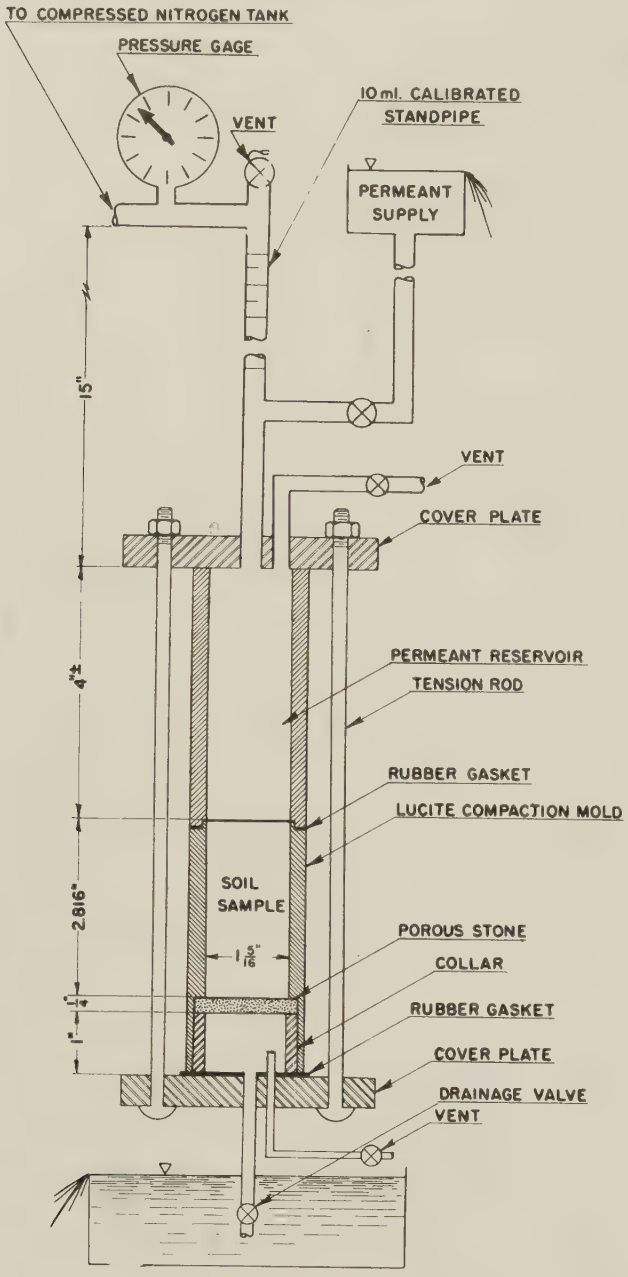

Fig. 1. Permeability test set-up

flexibility and self-sealing tendencies; these features are particularly desirable for blankets laid on soft foundations. The most important advantage of soil is, naturally, its low cost.

Where satisfactory soil is readily accessible, compacted soil is almost always the most economical material for a blanket, as evidenced by the extensive and successful use of soil blankets by the Bureau of Reclamation and the Corps of Engineers. The Bureau (7) found that the 2 to 3-ft. thick compacted soil blankets used on the Friant-Kern and Delta-Mendota Canals cost about one fifth as much per square yard of blanket in place as those of $3^1/_2$ to 4 in. of unreinforced cement concrete which were also used on the two canals. The cost of the soil blanket included a protective cover.

A few of the many Government-built dams which employ soil blankets to make their reservoirs water tight are: Caddoa Reservoir Project, Arkansas River; Franklin Falls, Pemigewasset River, N. H.; Birch Hill Dam, Millers River, Mass.; Kingsley Dam, North Platte River, Neb.; Blue Mountain, Petit Jean River; Denison Dam, Red River, Okla. Most of these blankets are in excess of 3 ft.

Soil is composed mostly of silicate minerals which are extremely resistant to chemical attack. Some consideration, however, must be given to the nature of the fluids which a blanket of soil, or any other material, must retain. High carbonate soils should not, for example, be used to retain acids. Expansive, gel-forming soils or even ones with high ion exchange capacities should be used only after study has been given to possible permeant-soil reactions. The impermeabilizing characteristics of sodium montmorillonite could be greatly reduced by an ion exchange reaction between the clay and an acid liquid. Shrinking and cracking could result from such an exchange.

The soil used in Otis lagoon blanket contains only 35%, by weight, clay minerals, and they are nonexpanding ones (illite and chlorite). Because of this nature and low content of clay mineral, the ion exchange capacity is small (the order of 8 milliequivalents per 100 grams). The permeability of Otis clay to the acid

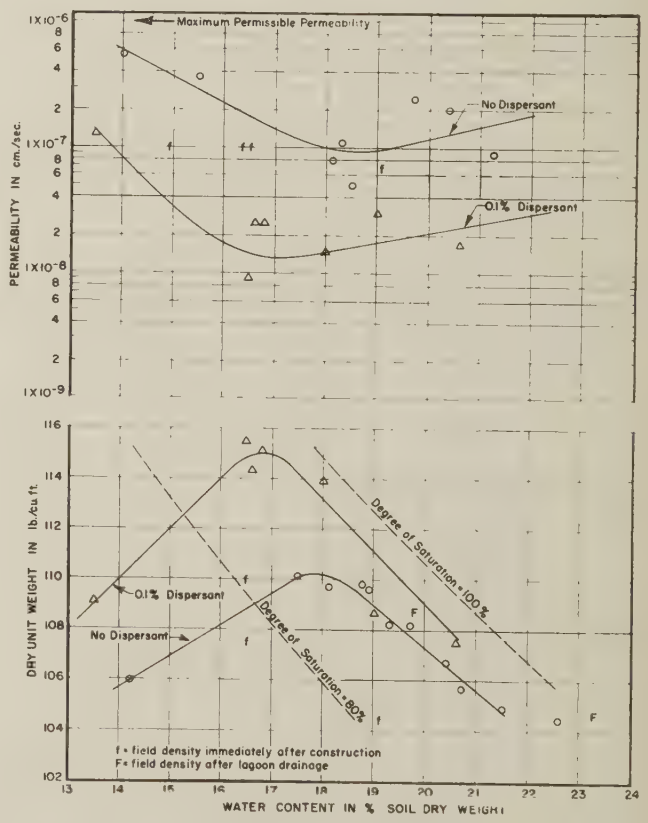

Fig. 2. Compaction and permeability tests

sulphite liquor should be essentially the same as to water. Many laboratory tests confirmed this expectation.

Blanket Thickness

Compacted soil blankets are usually in excess of 3 ft. A thinner blanket was considered for the Otis lagoon

because: (1) a supply of excellent soil was found, and (2) use of a trace chemical to reduce the permeability of the soil was planned. As the data presented later in this paper shown, treatment† with a trace amount of a dispersant reduced the permeability of the soil to one tenth of its untreated value. A blanket of 1 ft. thickness was selected because this is about as thin as can be practically constructed.

Required Blanket Permeability

The storage requirements of International Paper Co. were such that the maximum permissible leakage of the lagoon during a 16-week period was a drop in liquor depth from 20 to 14 ft. For this permissible leakage, computations showed that the permeability of a 1-ft. blanket would have to be 1×10^{-6} cm. per sec. or less. Since the blanket was not going to be placed over the entire lagoon bottom but only over the one half to two thirds which were known to be permeable, a permeability of 1×10^{-6} cm. per sec. was the absolute maximum permissible and the further the permeability below this figure the better.‡

LABORATORY TEST PROGRAM

Soil Classification

Since laboratory permeability tests showed all of the several soils from the Chisholm vicinity which were investigated would make good blanket material, the most accessible site was chosen. The properties of the blanket soil are given in Table I.

Table I. Properties of Blanket Soil

Particle size	>0.06 mm = 18% <0.06 mm >0.002 mm. = 63% <0.002 mm. = 19%
Plasticity	Liquid limit = 33% Plastic limit = 18%
Composition	Illite = 25% Chlorite = 10% Quartz = 40%

Test Procedure

The major laboratory test employed consisted of constant head permeability measurements on compacted samples using the setup shown in Fig. 1. The soil was first compacted in the sample mold with a compactive effort approximately equal that provided by sheepsfoot rollers in field construction. The mold was mounted in the setup, the permeant reservoir and standpipe then filled with permeant, and finally the permeability measured under any desired gas pressure. Readings of time and permeant level in the standpipe permitted computation of permeability.

Samples were compacted with and without dispersant for molding liquids of both water and sulphite liquor; permeability measurements were made for both water and sulphite liquor. The data showed that the permeability of the soil to the sulphite liquor was essentially the same as to water; a slightly higher density could be obtained by compacting with sulphite liquor rather than water. The possible advantage of using sulphite liquor as a compaction fluid was more than offset by the technical difficulties of handling the acid liquor. The

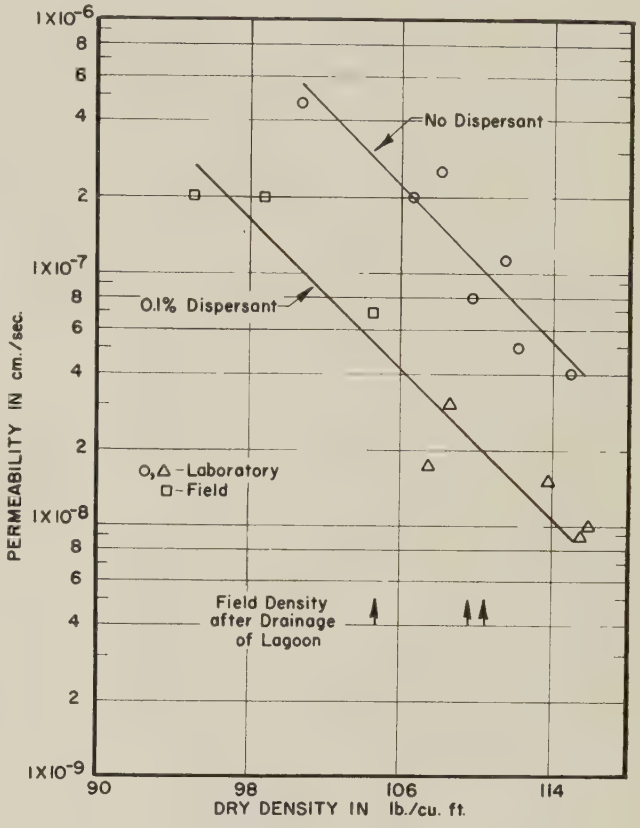

Fig. 3

borrow soil was in all cases so wet that the addition of molding fluid was not required. For these reasons the latter part of the laboratory test program was confined to water as the molding fluid and permeant.

Test Results

The dry unit weight or "density" and permeability measurements are plotted against molding water content in Fig. 2. While the data scatter, they follow the trends found characteristic of most fine-grained soils. The bottom part of Fig. 2 shows that a higher density, about 5 lb. per cu. ft., can be obtained by compaction with 0.1% of dispersant based on the dry soil weight. The maximum dry density for the soil with dispersant occurs at a water content about 1% lower than that of the natural soil. The top part of Fig. 2 shows that the minimum permeability occurs with compaction at, or slightly greater than, the moisture content for maximum density. The curves show that the use of 0.1% dispersant results in a minimum permeability of about one-tenth that obtained on the natural compacted soil.

In order to see if the reduced permeability caused by the dispersant could be entirely attributed to the denser compacted specimen or not, Fig. 3 was plotted. The data in this figure are dry density versus permeability for those samples compacted at, or wetter than, optimum moisture content. Figure 3 shows that a dispersant-treated compacted soil has a permeability one fifth of the natural soil when the two samples are

† The alteration of soil properties with dispersants is based on work by the first-named author in the M.I.T. Soil Stabilization Laboratory, and is described in (*2*).

‡ The Soil Conservation Service recommends that compacted soil for lining have a permeability of 1 ft. per year (0.966×10^{-6} cm. per sec.) or less. This maximum permissible permeability was set arbitrarily in view of the Service's experience and, interestingly, is essentially the same as the computed value for the Otis lagoon.

compared at the same density. This fact means that the increased density resulting from the dispersant accounts for only half of the permeability alteration. The remaining portion of the permeability reduction result-

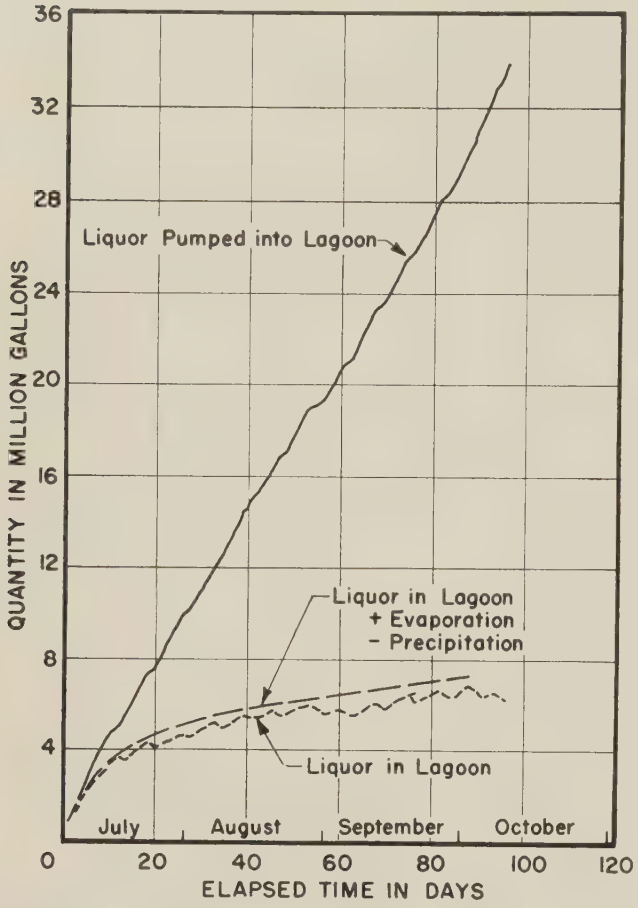

Fig. 4a. Lagoon leakage for 1952

ing from the addition of the dispersant is probably due to the higher order of particle orientation in the dispersed sample. This particle orientation results in a more tortuous seepage path and therefore reduced permeability.

Indicated by an arrow in the top part of Fig. 2 is the permeability 1×10^{-6} cm. per sec. which was the permeability computed for the maximum allowable lagoon leakage. The laboratory test program showed three important things, namely: (1) a permeability considerably smaller than the maximum permissible value could be obtained; (2) the addition of 0.1% of dispersant would result in a permeability of about one-tenth that of the compacted natural soil; (3) for best results, compaction should be done at a water content equal to, or greater than, the optimum for maximum density.

BLANKET CONSTRUCTION

Procedure

The area of the lagoon bottom to be covered with the soil blanket was determined from a study of the leakage records obtained by the International Paper Co. during the lagoon operation. Not to be covered were two areas, the west bank of the lagoon where bed rock outcropped and the bottom of the lagoon where there was a considerable accumulation of white water fines.

The lagoon blanket was constructed in two lifts, each lift consisting of the following steps:

1. Six inches of soil were dumped and spread.
2. The dispersant (sodium tetraphosphate) was spread at the rate of 5 lb. per 100 sq. ft.
3. The chemical and soil were mixed with a mechanical mixer.
4. The chemical and soil mixture was compacted with truck traffic and six passes of a sheepsfoot roller.

A protective cover of 3+ in. of sand was placed over the completed blanket. Sand was used rather than gravel or rip rap since the sand was available at the site.

The natural water content of the borrow soil varied from about optimum water content to approximately 28%. Both laboratory and field permeability tests showed that seepage forces transmitted by the permeant to the soil densified, with an accompanying reduction in permeability, soil compacted at, or wetter than, optimum. As already pointed out, the laboratory tests showed also that a permeability only a little greater than the minimum resulted from compaction on the wet side of optimum. In view of these facts and the desire to place the lagoon in service 2 weeks after the start of construction, operations were not delayed for the soil to dry.

Laboratory tests had shown that the soil could be diluted with sand with very little sacrifice in impermeabilizing characteristics. Hopes to use a sand-clay-chemical mixture were abandoned as soon as field operations showed that adequate mixing could not be obtained. The poor mixing was caused by the wet and sticky nature of the soil. Thorough chemical-soil incorporation was not essential since the percolating liquor helps distribute the dispersant throughout the soil. This phenomenon was observed in both laboratory and field tests.

Control Tests

Field construction was controlled by the measurements of permeability and density made with the same apparatus used in the laboratory. The laboratory apparatus was simply installed in a shack at the lagoon site. A cutting edge was made for the compaction mold

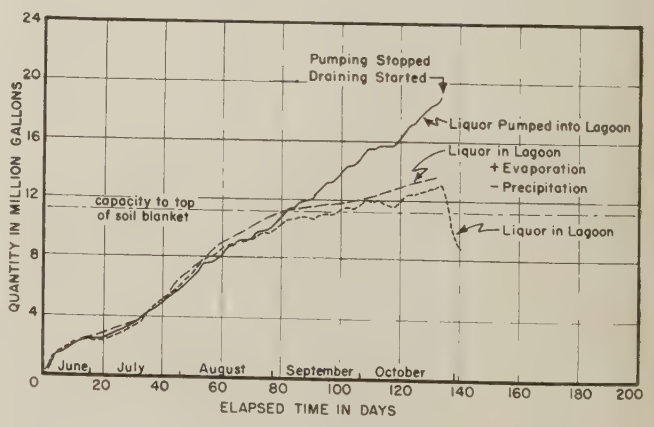

Fig. 4b. Lagoon leakage for 1953

and an undisturbed sample of the blanket was forced into the mold and tested in the field. Some of the field data are plotted in Fig. 2; much of the field data are not plotted since the water content was in excess of 23%.

The data show that the compacted density of the blanket was considerably lower than was obtained in the laboratory. As would be expected from the poor compaction, the permeability of the blanket was higher than obtained in the laboratory for samples at the same molding water content. This fact is illustrated by the four points shown in the top of Fig. 2.

Evaluation of Construction

Neither the mixing nor the compacting was as good as had been hoped. The blanket permeability, which, of course, is the only really important property, was in all cases considerably lower than the maximum permissible value of 1×10^{-6} cm. per sec. Based on the field permeability measurements and the assumption that the leakage through the untreated portions of the bottom was not excessive, the prediction was made that the total leakage from the lagoon would be insignificant. The data in the next section of this paper show that this assumption was a correct one.

In order to provide data which could be used by the mill and Mr. Lawrance, the River Master, to estimate the rate of seepage and projected date of arrival of such seepage at the river, three test wells, nos. 1, 2, and 3, were dug between the lagoon and river. Well no. 1 is 50 ft. from the lagoon, no. 3, 50 ft. from the river, and no. 2 midway between the other two, and 75 ft. from each. Readings of liquid level were periodically made in each well; samples from each well were analyzed for pH, temperature, and dissolved solids. Samples of liquor in the lagoon were also periodically tested.

The liquor inflow to the lagoon was measured with a 12-in. weir located on the core wall. The elevation of the liquor level in the lagoon was noted daily on elevation stakes graduated with $^1/_4$-in. marks. The volume in the lagoon for any depth was read from a depth-volume plot which had been made from the contour map of the lagoon. A rain gage and liquor evaporation pot were installed at the site and read daily.

After the lagoon was drained in November, 1953, a careful inspection of the blanket was made and several samples were taken. Densities of these samples are plotted in Figs. 2 and 3. The inspection and measurements showed the Summer's use had no ill effects on the blanket, but, in fact, densified it (with an accompanying permeability reduction).

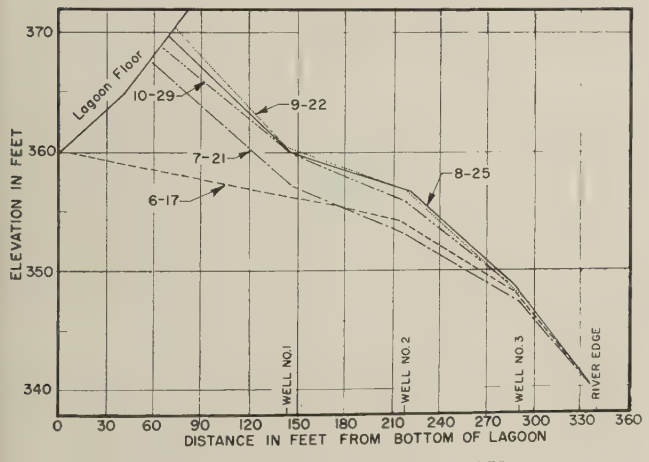

Fig. 5a. Pressure heads for 1952

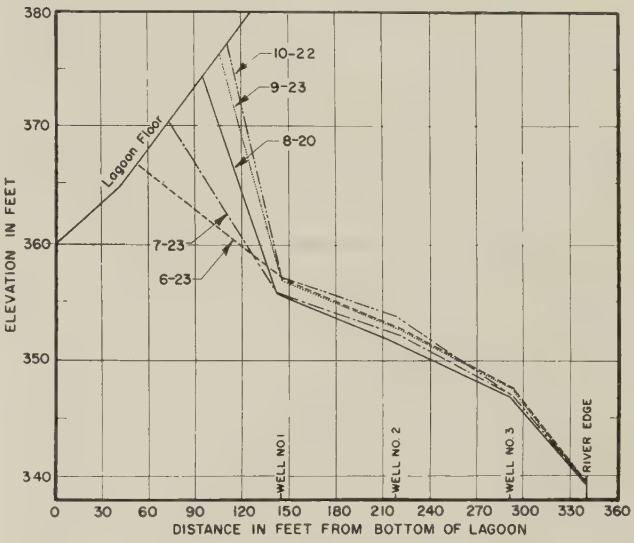

Fig. 5b. Pressure heads for 1953

Results of Field Measurements

Table II shows the days after filling started until sulphite waste liquor was observed at the river bank.

Table II. Time for Leakage to River

Year	*Days required for liquor to reach river bank*
1948	172
1949	194
1950	89
1951	64
1952	44
1953	Had not reached in 105 days, when drainage was started

The fact that less time for leakage was required in 1948 than 1949 is attributed to the high liquid level maintained in the lagoon during 1948 when the sealing with white water was attempted.

The data in Table II clearly show that, prior to the construction of the soil blanket, the liquor was reaching the river at increasingly shorter times.

In order to determine the leakage from the lagoon, measurements of evaporation and precipitation were necessary. These measurements are shown in Table III; they show that, for all years studied, evaporation was considerably greater than precipitation.

Table III. Evaporation and Precipitation

	1948 6/22–9/20	*1949 6/14–9/25*	*1950 6/16–9/18*	*1951 6/26–9/20*	*1952 7/7–10/11*	*1953 6/15–9/20*
Evaporation, in.	56.13	43.25	28.59	22.93	27.93	40.38
Precipitation, in.	10.03	12.63	14.18	12.50	7.08	10.82
Loss by evaporation, in.	46.10	30.62	14.41	10.43	20.85	29.56
Ratio of evaporation to precipitation	5.60	3.42	1.98	1.83	3.94	3.73

Figures 4a and 4b present leakage data for 1952 and 1953, respectively. The accumulative quantity of liquor pumped into the lagoon is shown by the solid

line; the measured volume of liquor in the lagoon, by the dotted line; and, the quantity in the lagoon plus evaporation minus precipitation, by the dashed line. Figure 4a shows that little leakage occurred at volumes below 3 million gal., but that above this value, leakage occurred at an increasing rate. The first 3 million gal. is contained in the center of the lagoon which had been made fairly impervious with the pulp. As the quantity is increased above 3 million gal., not only is the liquid head increased, but also the more permeable parts of the lagoon floor are submerged. This fact accounts for the sharp increase of leakage.

Figure 4b presents corresponding data for 1953, after the blanket had been constructed. The data show that, within the range of experimental error, essentially no leakage occurred until the top of the blanket was reached. When the liquor reached the parts of the lagoon with no blanket, substantial leakage occurred.

Figures 5a and 5b show the levels of liquor between the lagoon and river before and after blanket construction. Before the blanket was placed, the piezometric head in each well generally rose as the lagoon was filled, as shown by Fig. 5a. Figure 5b, however, illustrates dramatically that essentially no rise in liquor level occurred in the wells as the liquor was pumped into the lagoon. Nearly all of the liquor head is lost in the blanket; this fact is further proof of practically nil leakage through the blanket.

Lagoon Selection and Operation

The advisability of a lagoon, the selection of lagoon size, the method of operation, etc., are considerations outside the scope of this paper; they depend on circumstances existing at a particular site. The short-term storage of waste liquor to regulate its rate of release into the Androscoggin is a practical answer to the disposal problem of the Otis mill; it is not necessarily the answer to pollution or lagoon problems elsewhere.

Consideration must be given to the purging of the liquor from the pores of the soil through which it flows to the river. This purging is accomplished at the Otis mill by filling the lagoon with river water to a depth above the blanket. The leakage of water over the blanket helps the regular groundwater flush the soil pores. Keeping the lagoon filled with water during the Winter also protects the blanket from the deleterious effects of freeze-thaw cycles.

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Mr. Anderson directed the collection and analysis of the leakage and head measurements. W. C. Stevens, sulphite superintendent at the Otis mill, was field engineer on the blanket construction. The blanket was constructed by Sanders Construction Co., of Portland, Me. The construction operations were supervised by Eric Sanders and Stanley Gordon. Mr. Lambe designed the blanket and performed the soil laboratory and field tests. He was aided by Clyde N. Baker, Jr., research assistant in the M.I.T. Soil Stabilization Laboratory.

A Corrosion Study in a Chlorine Dioxide Pulp Bleaching Plant

H. O. TEEPLE and R. L. ADAMS, JR.

A corrosion survey was made in the chlorine dioxide plant of Riegel Carolina Corp. in an effort to secure useful information with respect to the performance of various metals and alloys in chlorine dioxide service. These results are considered along with the performance of nonmetallic materials such as ceramics and plastics based on experience obtained by Riegel Carolina Corp.

WITHIN the last few years, chlorine dioxide has been accepted as a commercially feasible chemical useful for pulp bleaching, the main reason for this being the development of practical means of chlorine dioxide generation at the plant site. A rather complete review of methods of the preparation of chlorine dioxide was given by Casciani (*1*).* This is also discussed in the TAPPI Monograph on "The Bleaching of Pulp" (*2*).

Since chlorine dioxide solutions are corrosive, the use of this chemical for pulp bleaching is largely dependent upon finding suitable materials of construction available in useful forms. This has been a problem although considerable progress has been made. Several articles have appeared (*3–8*). Harrison (*3*) presented the following tabular summary of corrosion-resistant materials of construction.

1. Saran pipe—Satisfactory for reactor or chlorine dioxide solution.
2. Kel-F—Satisfactory for valve diaphragms for reactor and chlorine dioxide.
3. Durichlor—Excellent for both solutions—pumps.
4. Karbate—Used for heat exchanger tubes and thermometer wells in reactor solution—satisfactory where pressure in line is low—one year limited life is expected.
5. Stainless steels 316 and 304—Not satisfactory.
6. Chemical stoneware—Satisfactory if protected from thermal shock.
7. Porcelain—Satisfactory.
8. Alkor cement—Satisfactory if no movement of joint takes

* Attention is also called to the paper by Rapson (*10*) on a comparison of processes.

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place. Unsatisfactory where the joint can be eroded such as in a mixer.

9. Vitroplast—Excellent even in a mixer.
10. Saran rubber—used for gaskets—not resistant. Becomes resistant when coated with Sarancote.
11. Tygon—Used for gaskets—better than Saran rubber but not perfectly resistant—becomes hard.
12. Teflon—Satisfactory—has been used for head gaskets on reactor pumps, pump packing, pipe gaskets.
13. Hastelloy C—Not satisfactory for reactor solution—probably satisfactory for chlorine dioxide solution—used in mixer.
14. Ircamet—Probably not satisfactory for reactor solution—satisfactory for chlorine dioxide solution—pumps.
15. Chemical brick—Satisfactory.
16. Sodium silicate cement—Satisfactory in top of chlorine dioxide tower as long as conditions are on the acid side.
17. Glass—Satisfactory.
18. Sarancote—Generally satisfactory but is showing some deterioration on one tank cover.
19. Atlastavon 30—Probably satisfactory in light of existing data. Laboratory data—excellent.

Schuber and Kraske (*4*) mentioned that "Stoneware, porcelain, or steel with membrane backing an acid-brick lining pointed with Vitroplast cement are acceptable for reactor and absorber towers. Piping Saran-lined steel, or porcelain. Heat exchangers are Karbate. Installed pumps are Durichlor and Ircamet. Kel-F is used for valve diaphrams, and Teflon for packings." Heitman (*5*) mentioned that "materials of construction for the portions of the generator (using sulphur dioxide) in contact with the reactor charge and the evolved gases were limited to unplasticized Saran, unplasticized polyvinylchloride, ceramics, or glass." He mentioned that "rubber undergoes a slow deterioration under the influence of chlorine dioxide and sulphur dioxide mixtures. . . . . Hard rubber piping embrittled and lost its cohesive structure. Unplasticized Saran piping, on the other hand, showed no change in structure or evidence of wear." Other comments are included for valves made of unplasticized PVC, glass silicon carbide cooling coils. Woodside and MacLeod (*6*) presented a chart showing a flow sheet for chlorine dioxide generation (sulphur dioxide) and listed materials of construction suggested for the various pieces of equipment. Saran, Karbate, Durichlor, lead, and ceramics are listed. Seymour and Smith (*8*) mentioned the use of unplasticized polyvinylchloride and also made the very good point that a pinhole or an imperfection in the plastic will ruin the entire lining.

This paper presents the results of a study in the chlorine dioxide bleach plant at Riegel Carolina Corp. at Acme, N. C. The purpose of the study was to obtain corrosion data for a number of metals and alloys. The materials of construction chosen for test were purposely varied to be able to present a rather complete picture. The nominal compositions of the metals and alloys tested are shown in Table I. Some of the materials chosen were expected to show good resistance to corrosion and others chosen were suspected to show less resistance to corrosion by the environments encountered. The point is that even if certain materials can be shown to be unsatisfactory this information should be helpful to the mills. Similarly those materials showing good resistance to corrosion should be favorably considered. These data on metallic materials of construction should be regarded as complementary to the information presented by others on the performance of plastics. Since chlorine dioxide solutions are quite corrosive, advantage should be taken of any materials of construction which have proved themselves useful. It is probable that the most economic materials chosen for a chlorine dioxide bleach plant will be both metallic and nonmetallic.

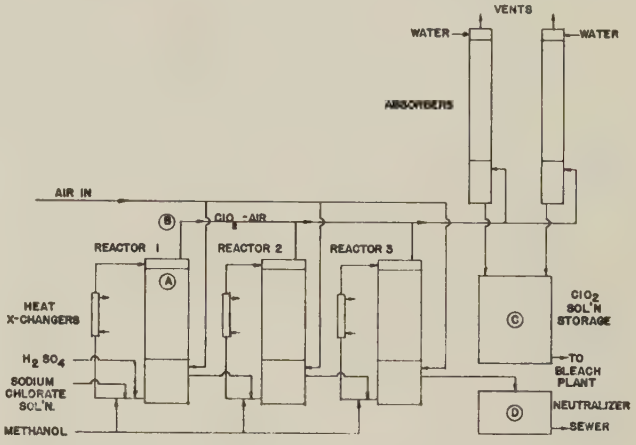

Fig. 1. Solvay method ClO_2 manufcature

It will be noted the data presented here are based upon rather short durations of specimen exposure. This is not unreasonable because of the corrosiveness of the environments. The only qualifying comment has to do with the ultimate performance of certain materials which are susceptible to pitting when low weight loss corrosion rates are in effect.

The story of the Riegel Carolina operation was presented by Harrison (*3*). Figure 1 shows a schematic flow sheet for the methanol reduction of sodium chlorate in acid to make chlorine dioxide. The encircled letters indicate the locations of the test specimens in the chlorine dioxide generation process. Figure 2 shows a schematic flow sheet for the pulp bleaching operation. The encircled letters indicate the location of the test specimens in this portion of the process.

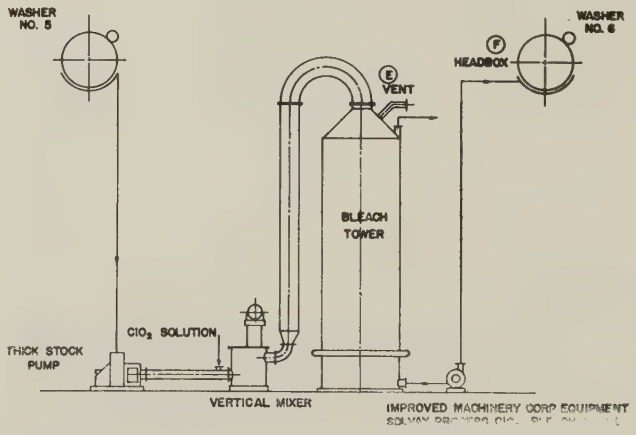

Figure 2. Riegel Carolina Corp. ClO_2 bleach stage

The data were developed by field tests utilizing a specimen holder in accordance with ASTM Recommended Practice for Conducting Plant Corrosion Tests, A 224–46 (*9*). This device is pictured in Fig. 3.

In the present instance, the specimen holders were constructed of type 316 stainless steel structural parts and Teflon was used for galvanic insulation between the specimens themselves and also between the specimens and the structural parts. It is admitted the use of type 316 structural parts was not good but availability was important. The stainless did last for the duration of all tests except test A. In this case, the specimen holder came apart but all of the specimens existing at the end of the test period were retrieved.

With two exceptions, there were duplicate specimens of all metals or alloys on each specimen holder and the corrosion rate shown for a given material is the average of the rates shown for each duplicate specimen. The two exceptions are tantalum and LaBour R-55. Due to an insufficient number of specimens, only one specimen of each material was used on the specimen holder.

Test A was made in the top of the no. 1 chlorine dioxide reaction tower, the specimens being exposed on the distributor plate. These towers are ceramic and packed with ceramic Raschig rings. Durichlor pumps are used to handle the sodium chlorate-sulphuric acid solutions and service life is reported indefinite.

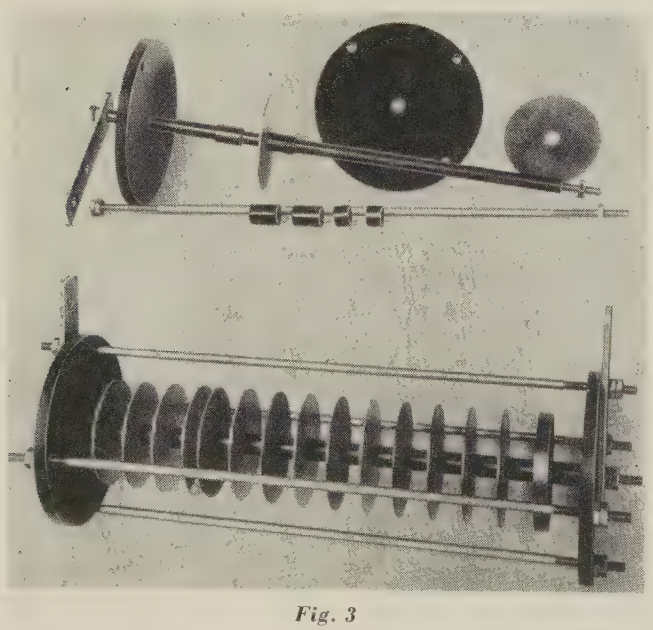

Fig. 3

It should be noted that the heat exchangers associated with each of the three reactor towers are made of Karbate which has proved quite satisfactory. These have been in service since the start-up of the chlorine dioxide bleach plant in June, 1952.

The environment in test A consisted of a solution of 60° Bé. sulphuric acid, 32% sodium chlorate, methanol, and chlorine dioxide gas at 135°F. There was some aeration and the flow rate of the solution was 60 g.p.m. The duration of test was 351 hr. The results are:

Table I. Nominal Compositions[a]

Metal or alloy	*Nickel*	*Chromium*	*Molybdenum*	*Copper*	*Lead*	*Silicon*	*Iron*	*Others*
Nickel	99.4	..	..	..	..	..	..	..
Inconel	78	15	..	..	..	..	7	..
Monel	67	..	..	30	..	..	1.4	..
Hastelloy C	55	16	17	..	..	1 max.	6	4 tungsten
Chlorimet 3	60	18	18	..	..	..	3	..
LaBour R-55	52	23	4	4	..	4	10	2 tungsten
Durimet 20	29	19	3	4	..	1	Bal.	..
Type 316 stainless steel	11	17	2.5	..	..	1 max.	Bal.	..
Type 304 stainless steel	10	19	..	..	..	1 max.	Bal.	..
Type 430 stainless steel	..	16	..	..	..	1 max.	Bal.	..
Duriron	..	..	..	..	..	14.5	Bal.	..
Durichlor	..	..	3	..	..	14.5	Bal.	..
88/10/2 Bronze	..	..	..	88	..	..	..	10 zinc 2 tin
Chemical lead	..	..	..	0.08 max.	99.9	..	..	..
Tantalum	Commercially pure tantalum							

[a] These compositions are shown for general interest only. For detailed composition, consult supplier.

Test A

Material	*Corrosion rate, i.p.y.*[a]	*Remarks*
Tantalum	0.0001	No attack
LaBour R-55	0.002	No pitting
Durichlor	0.003	Incipient pits
Chemical lead	0.006	Etched
Duriron	0.007	Etched
Hastelloy C (cast)	0.013	No pitting
Chlorimet 3	0.020	No pitting
Durimet 20	0.027	0.059 max. pitting[b]
Type 316 stainless steel	0.15	Perforated 0.031 in.[c]
Inconel	> 0.37	Spec. corroded away[d]
Type 430 stainless steel	> 0.46	Spec. corroded away[d]
Monel	> 0.48	Spec. corroded away[d]
Nickel	> 0.48	Spec. corroded away[d]
Type 304 stainless steel	> 0.55	Spec. corroded away[d]
88/10/2 Bronze	> 1.8	Spec. corroded away[d]

[a] Corrosion rate expressed in terms of inch penetration per year based upon the continuous exposure of one surface.
[b] One of the two duplicate specimens showed no pitting on the surface but was perforated (0.189 in. in 351 hr.) under the spacer, i.e., in a crevice. The other duplicate specimen showed the max. pitting as indicated.
[c] Both duplicate specimens were perforated (0.031 in. in 351 hr.) and there was gross subsurface corrosion up to 1/4 in. back from the specimen edges.
[d] Specimen corroded away during exposure period. Minimum corrosion rate is shown.

The data show that the nickel-base alloy LaBour R-55, the high silicon irons, and chemical lead all have corrosion rates low enough to show a useful service life. If one wished to use an alloy with more favorable mechanical properties than the Durichlor now being used for pumps, it appears that the R-55 alloy would be a reasonable choice.

Test B was made in the chlorine dioxide gas line to the absorber. Porcelain piping with type 316 stainless steel joints is used and the service life of the joints is erratic. The environment at this point consists of chlorine dioxide gas, about 8 to 10% by volume, and there is also present some condensed chlorine dioxide

solution. The flow rate is 250 c.f.m., the temperature is 150°F., and the duration of test was 350 hr. The results are:

Test B

Material	*Corrosion rate, i.p.y.*	*Remarks*
Tantalum	0.0001	No attack
Durichlor	0.003	No pitting
Chlorimet 3	0.015	No pitting
Chemical lead	0.030	No pitting
Hastelloy C (cast)	0.046	No pitting[a]
Durimet 20	0.19	Perforated[b]
Type 316 stainless steel	0.29	Perforated[c]
Inconel	0.30	Perforated[d]
Type 304 stainless steel	0.33	Perforated[e]
Nickel	0.35	Etched[f]
Monel	0.36	Etched[f]
Type 430 stainless steel	0.40	Perforated[e]
LaBour R-55	0.46	0.095 in. max. pitting
Duriron	0.62	Gross attack[g]
88/10/2 Bronze	0.68	Heavy etch

[a] Subsurface corrosion on one of duplicate spec.
[b] Specimen perforated (0.189 in.) during exposure period.
[c] Specimen perforated (0.031 in.) during exposure period—two thirds of specimen missing.
[d] Specimen perforated (0.031 in.) during exposure period—specimen looks like filigree.
[e] Specimen perforated (0.031 in.) during exposure period—one third of specimen missing.
[f] One half of specimen missing.
[g] Also deep pitting.

It was observed upon the removal of this specimen holder from test that the upper portions of some of the specimens were corroded away (see footnotes *c*, *d*, *e*, and *f* of test B). The lower portion of the specimen holder was immersed in the condensed chlorine dioxide solution. Therefore, this corrosive environment is probably more severe than the weight loss data indicate.

These data confirm the fact that the service life of the type 316 stainless fittings is erratic. It would appear Durichlor fittings could be used here. The fact that this alloy is brittle should not detract too much from its apparent serviceability because the porcelain

Test C

Material	*Corrosion rate, i.p.y.*	*Remarks*
Tantalum	0.0001	No attack
Duriron	0.0001	No pitting
Durichlor	0.0001	No pitting
Type 316 stainless steel	0.0001	No pitting
Durimet 20	0.0007	No pitting
LaBour R-55	0.0036	No pitting
Hastelloy C (cast)	0.0050	No pitting
Type 304 stainless steel	0.0051	Incipient pitting[a]
Chlorimet 3	0.014	Macro etch
Type 430 stainless steel	0.025	Perforated[b]
Inconel	0.11	Perforated[c]
Chemical lead	0.21	No pitting
Nickel	0.32	Etched[d]
88/10/2 Bronze	0.34	Heavy etch
Monel	0.48	Specimen almost gone

[a] Specimen pitted 0.018 in. under spacer (crevice) during exposure period.
[b] Specimen perforated 0.031 in. in line of rolling direction during exposure period.
[c] Specimen perforated 0.031 in. during exposure period.
[d] Severe intergranular corrosion.

piping is also quite fragile. If a wrought material was preferred for the fittings, it seems that Saran or PVC lined steel fittings would be better than the stainless. The corrosion data indicate that few, if any, other commercially available metallic materials would be expected to be suitable.

Test C was made in the chlorine dioxide solution receiver tank. The concentration of chlorine dioxide was 4 to 5 grams per liter, the pH was 2 to 3.5, the temperature was 36°F., the duration of test was 351 hr. Saran lining in pipe and the tank has proved to be quite satisfactory.

These data indicate that a number of cast and wrought materials may be suitable for this service. However, this is an instance wherein some caution is indicated in the choice of the alloy or metal. Because of the low weight loss corrosion rates of some of the alloys, such as type 316 stainless, it follows that the duration of test may not have been of sufficient duration to provide reliable information with respect to the pitting tendencies of the alloy. A clue to this is indicated by pitting observed on types 304 and 430 stainless steels and Inconel.

Test D was made in the neutralizer tank. The solution contained 45% sulphuric acid, 20 grams per liter sodium chlorate, the temperature was 155°F., the flow rate was 2 to 5 g.p.m., the duration of test was 350 hr. Saran-lined pipe and acid brick lined tank are used for this service. The results are:

Test D

Material	*Corrosion rate, i.p.y.*	*Remarks*
Tantalum	0.0001	No attack
Durichlor	0.0004	No attack
Durimet 20	0.0011	No pitting[a]
LaBour R-55	0.0016	No pitting[a]
Duriron	0.0021	No pitting[a]
Type 316 stainless steel	0.0025	No pitting[b]
Chemical lead	0.0031	No pitting[b]
Chlorimet 3	0.0085	No pitting[b]
Hastelloy C (cast)	0.0087	No pitting[b]
Inconel	0.010	No pitting[b]
Type 304 stainless steel	0.016	Perforated[c]
Type 430 stainless steel	0.031	Perforated[d]
Monel	> 0.48	[e]
Nickel	> 0.49	[e]
88/10/2 Bronze	> 1.8	[e]

[a] One of the two duplicate specimens was pitted 0.007 in. beneath spacer.
[b] Specimens perforated (0.031 in.) under spacer during test period.
[c] Specimens perforated (0.031 in.) at the outer edges during test period.
[d] Specimens perforated (0.031 in.) during test period and gross attack at specimen edges.
[e] Minimum rate—specimens corroded away during test period.

These results indicate that a number of both cast and wrought metals and alloys are suitable for this service. Stagnant conditions or the presence of crevices would generally preclude the use of the austenitic stainless steels. Chemical lead might be a suitable metal to use as a lining. A number of alloys seem to be suitable for pumps.

Test E was made in spent chlorine dioxide gas in the vent line from the bleach tower. The temperature was 155°F. and the duration of test was 338 hr. The results are:

In placing this specimen holder on test it was not possible to expose the specimens as far down the vent line as was desired. Hence, only intermittent exposure to the spent chlorine dioxide gas was achieved.

While the data indicate low weight loss corrosion rates for a number of metals and alloys, these conditions would seem to indicate that caution should be exercised because of the pitting tendencies exhibited. Probably the better choice of a material of construction would lie in the direction of the nonmetallics.

Test F was made in the headbox of the no. 6 pulp washer. Kraft pulp stock at pH 9.5 to 10, tempera-

Test E

Material	Corrosion rate, i.p.y.	Remarks
Tantalum	0.0001	No attack
Durichlor	0.0001	Incipient pitting
Hastelloy C (cast)	0.0002	No attack
Durimet 20	0.0002	No attack
Chlorimet 3	0.0003	No attack
Duriron	0.0004	Incipient pitting
Type 316 stainless steel	0.0005	Pitted[a]
Type 304 stainless steel	0.0006	Pitted[a]
Monel	0.0006	Incipient pitting
Nickel	0.0007	Slightly etched
Inconel	0.0007	Perforated[b]
Type 430	0.0009	Pitted[c]
88/10/2 Bronze	0.0052	Localized etching
Chemical lead	0.014	Pitted 0.035 in. max.[d]

[a] Two severely pitted areas on each specimen, otherwise surface is good.
[b] Only one perforation on each specimen, otherwise surface is good.
[c] Only one severely pitted area on each specimen, otherwise surface is good.
[d] Average pit depth 0.025 in.

ture was 155°F., there was moderate aeration, the stock flow rate was 4500 g.p.m., the duration of test was 337 hr. The vat was tile lined, the washer deck was type 316 stainless with an estimated wire life of 9 to 12 months. The results are:

Test F

Material	Corrosion rate, i.p.y.	Remarks
Tantalum	0.0001	No attack
Type 316 stainless steel	0.0001	Incipient pitting
Duriron	0.0001	No attack
Durichlor	0.0001	Incipient pitting
Durimet 20	0.0002	No pitting
Type 304 stainless steel	0.0003	Incipient pitting
Hastelloy C (cast)	0.0005	No pitting
88/10/2 Bronze	0.0023	Slightly etched
Type 430 stainless steel	0.0038	Pitted 0.005 in.
Chlorimet 3	0.0064	No pitting
Inconel	0.0067	Pitted 0.005 in.[a]
Chemical lead	0.010	Etched
Monel	0.016	Pitted 0.015 in. max.
Nickel	0.021	Etched

[a] Specimens slightly blistered at pits.

The clue to limited service life of type 316 stainless steel wires in this service is provided by the incipient pitting noted on the type 316 stainless steel test specimens. In addition to pitting on the surface, the stainless would be expected to be susceptible to oxygen concentration cell corrosion in the crevices. The wires fail due to this cause more than any one other reason not withstanding the low weight loss corrosion rate. Since type 316 is the most available alloy in the forms desired and at a moderate price and at the same time possessing fairly good potential resistance to corrosion by this environment, it would seem reasonable to see what might be done to reduce the corrosiveness by operational or process changes. Such a change was effected by the addition of caustic to the stock to increase the pH to its present level. However, the extent of this change would be governed by the conditions necessary to produce the product desired.

In summary, the data developed in this study and plant experience would appear to justify the following conclusions:

1. Tantalum shows excellent resistance to corrosion by any of the environments encountered and appears to be quite foolproof.

2. Durichlor shows good resistance to attack and appears to be limited only by its mechanical properties and forms available. Failures have occurred due to shattering resulting from imbalance and vibration.

3. Duriron, while showing a high corrosion rate in test B, seems to deserve no preference over Durichlor and further has the same limitations of mechanical properties and forms available as does Durichlor.

4. Hastelloy C, cast, and Chlorimet 3 appear to have intermediate corrosion resistance and, therefore, have limited application. It is worthy of note that the weight loss corrosion rates for these two equivalent alloys were somewhat at variance. Hastelloy C has been used successfully for rotameter bobs and also for a connecting pipe between the chlorine dioxide mixer and the retention leg of the bleach tower.

5. LaBour R-55, with one exception, appears to be a good corrosion resisting alloy possessing quite favorable mechanical properties and probably is worthy of consideration. The one exception being condensed chlorine dioxide solution (test B) wherein the corrosion rate is high.

6. Chemical lead shows good to poor corrosion resistance and hence would have limited application. Its mechanical properties also contribute to its limited use.

7. Type 316 stainless and Durimet 20, in general, cannot be depended upon to provide satisfactory service. In some instances the weight loss corrosion rates are high and in other instances where the rates are low, the alloys are subject to localized attack. Experience has shown both these alloys susceptible to intergranular failure which was noted on some specimens.

8. Types 304 and 430 stainless steels, Monel, nickel, Inconel, and 88/10/2 cast bronze are not suitable for any applications in chlorine dioxide bleach plant service as has been shown by the date developed.

It is to be noted that the chlorine dioxide generating plant at Riegel Carolina was the first of its kind to be operated in a pulp mill. As a consequence materials were used on a trial and error basis and, of course, some materials were found to be unsatisfactory. The lack of information on metallic materials prompted this study.

In conclusion, it is believed these data are quite useful and should serve to fill in a few gaps with respect to existing information on the subject of materials of construction for chlorine dioxide pulp bleaching plants.

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Acknowledgment is made to C. E. Hartford of Riegel Carolina Corp. for his generous cooperation in making this study possible.

Received March 25, 1954. Presented at the 39th Annual Meeting of the Technical Association of the Pulp and Paper Industry, New York, N. Y., Feb. 15–18, 1954.

ASSOCIATION NEWS AND EVENTS

Local Section Meetings

Pacific: March 4, 1955, Everett, Wash., Shibley Award Program. May 18–21, Empress Hotel, Victoria, B. C., joint meeting with Pacific Div., APPM Superintendents Association and Pacific Branch CPPA Technical Section.

Kalamazoo Valley: Feb. 3, 1955, Hotel Harris, Kalamazoo, Mich.—"The Technical Man Looks at Practical Mill Problems"; "Stock Treatment," by Stephen Kukolich, Lee Paper Co., Vicksburg, Mich.; "Trouble Shooting," by W. F. Hathaway, Kalamazoo Vegetable Parchment Co., Kalamazoo, Mich.; and "Bleaching," by Arthur Hupp, Watervliet Paper Co., Watervliet, Mich. March 3, 1955, Graphic Arts Meeting, Peter Moffett, Kalamazoo Vegetable Parchment Co., chairman. April 7, 1955, Engineering Meeting, D. B. Gearhart, General Electric Co., chairman. May 5, 1955, Western Michigan College theses presentations—"What Lies Ahead," by Elmer K. Stilbert, Jr., Dow Chemical Co., Midland, Mich. June, 1955, Gull Lake Country Club, annual meeting.

Chicago: March 21, 1955; April 18, 1955; May 16, 1955.

Lake States: March 8, 1955, Elks Club, Kaukauna, Wis., afternoon visit to mill of Thilmany Pulp & Paper Co. April 12, 1955, Conway Hotel, Appleton, Wis., Clarence J. West Memorial Award Program. May 10, 1955, annual meeting.

New England: April 11, 1955, Bond Hotel, Hartford, Conn. June 3–4, 1955, Oceanside House, Magnolia, Mass., annual meeting.

Ohio: Feb. 10, 1955, American Legion Hall, Middletown, Ohio, "A Comparison of Printing Processes," by Marvin C. Rogers. March 8, 1955, Manchester Hotel, Middletown, Ohio, "The Use of Optical Instruments," by Richard S. Hunter. April 14, 1955, American Legion Hall, Middletown, Ohio, panel discussion on "The Use of Pigments." May 12, 1955, C. G. & E. Co., Hartwell Clubhouse, Cincinnati, Ohio, annual meeting.

Lake Erie: Feb. 11, 1955, Hotel Carter, Cleveland, Ohio, "Industrial Psychology." March 11, 1955, "Measurement and Control in the Graphic Arts." April 15, 1955, "Recent Developments in Printing Inks." May 13, 1955, annual meeting.

Delaware Valley: Jan. 27, 1955, Engineers Club, Philadelphia, Pa., Graphic Arts meeting; joint meeting with the Philadelphia Printing Ink Makers' Production Club (panel discussion). March 24, 1955, "Paper Mill Management," by K. O. Elderkin, Bowaters Southern Paper Corp., Calhoun, Tenn. May 26, 1955, Edward J. Albert Award Competition.

Empire State: June 9–11, 1955, Whiteface Inn, Lake Placid, N. Y., annual meeting.

Empire State (Metropolitan District): Fraunces Tavern, New York, N. Y. March 8, 1955, panel discussion on "Printing." April 12, 1955, "Fundamentals of Stock Preparation." May 10, 1955, annual meeting.

Empire State (Northern District): Woodruff Hotel, Watertown, N. Y. Feb. 10, 1955, paper by Wilfred Gallay, E. B. Eddy Co., Hull, P. Q. March 10, 1955, panel discussion on "Basic Weight and Caliper Control." April 14, 1955, TAPPI Award Paper meeting. Talk by James Sisson. May 11, 1955, annual meeting.

Empire State (Western District): Feb. 2, 1955, Visit to plant of J. W. Clement Co., Buffalo, N. Y. March 8, 1955, joint meeting with CPPA Technical Section, Niagara Branch. April 6, 1955, "Availability of Raw Materials" (Suppliers Night). May 4, 1955, Lockport, N. Y., annual meeting.

Empire State (Eastern District): Glens Falls Country Club, Glens Falls, N. Y. Jan. 20, 1955; Feb. 17, 1955; March 17, 1955; April 21, 1955; May 21, 1955, annual meeting.

Empire State (Central District): University Club, Syracuse,

Ninth Engineering Conference Luncheon, Philadelphia, Pa., Oct. 20, 1954

General view of the Engineering Division luncheon

N. Y. Feb. 4, 1955, "Screening," by H. F. Schenk, Magnus Metal Co., Fitchburg, Mass. March 4, 1955, "New Developments in Paper Machine Design," by Earl H. Swartz, Beloit Iron Works, Beloit, Wis. April 2, 1955, "Interesting Developments in Titanium Research," by H. C. Brill, Pigments Dept., E. I. du Pont de Nemours & Co., Inc., Newark, Del. May 6, 1955, New York State College of Forestry, Seniors' Night. June 3, 1955, annual meeting.

Maine-New Hampshire. To be announced.

Southeastern. March 18–19, 1955, George Washington Hotel, Jacksonville, Fla. May 13–14, 1955, De Soto Hotel, Savannah, Ga.

TAPPI Annual Meeting

The program of the Annual Meeting of the Technical Association of the Pulp and Paper Industry is published elsewhere in this issue of *Tappi*. It will be held at the Commodore Hotel on Feb. 21–24, 1955. Registration will begin at 4:00 p.m. on the ballroom floor of the Commodore and will continue until 8:00 p.m. Members of the Association are reminded to have their membership cards available at the time of registration. A higher registration fee will be charged to individuals who do not have their 1955 membership cards with them. All individuals who attend the meeting or occupy hotel rooms are required to register.

Canadian Meeting

The annual meeting of the Technical Section of the Canadian Pulp and Paper Association will be held at the Sheraton-Mt. Royal Hotel, Montreal, P. Q., on Jan. 26–28, 1955. Requests for room reservations should be sent to T. Devean at the Sheraton-Mt. Royal, Peel St., Montreal, P. Q.

Papers covering the following subjects have been programmed: Drier Felt Permeability, Closed Hoods, Machine Speed Control, Gas vs. Electric Trucks, Roll Grinding, Printing Problems, Sewer Sampling Methods, High Yield Sulphite, Fire Fighting Procedures, The Norman Chipper, and Measuring Pulp Yields.

Geoffrey Broughton Scholarship Fund

Geoffrey Broughton, who was very active in TAPPI, died on Sept. 10, 1954. He was the head of the Department of Chemical Engineering at the University of Rochester, Rochester, N. Y. To perpetuate his memory a Geoffrey Broughton Scholarship Fund Committee has been established to receive donations. A fund of $2500 is desired. Contributions to be made payable to the University of Rochester should be sent to Clarence Wynd, chairman, Advisory Committee, Department of Chemical Engineering, University of Rochester, Rochester, N. Y.

Corrosion Round-Table

The Corrosion Committee will sponsor a round-table discussion on vessel design and its effect on alleviating digester corrosion on Sunday, Feb. 20, 1955, at 10:00 a.m. The meeting will be at the Commodore Hotel, New York City. The room will be indicated on the daily function board.

To those people who are interested in this subject, the Corrosion Committee extends an invitation to participate in the discussion.

Engineering Division Day

The Annual Meeting of the Association will feature an Engineering Division Day on Tuesday, Feb. 22, 1955, at the Commodore Hotel, New York City. This will be the first year in which the division has conducted a program at the February meeting.

The general session on Monday, February 21, will feature an address by R. Buckmeister Fuller, world-renowned architect. The committee of the division will meet on Monday afternoon.

On Tuesday morning, February 22, the following papers will be presented:

1. "Modern Architecture in Pulp and Paper Mills," by Mario C. Celli, Celli-Flynn, McKeesport, Pa.
2. "The Sulzer System for Water Removal," by Robert Thomann, Sulzer Bros., Winter Thur, Switzerland.
3. "Graphical Determination of Roll Deflection," by R. C. Sturken and D. A. Verner, Frank W. Egan Co., Bound Brook, N. J.
4. "Application and Maintenance of Paper Stock Pumps," by E. Schwandt, Gould Pumps, Inc., Seneca Falls, N. Y.

On Tuesday afternoon there will be a meeting of the engineering division to discuss plans for the Tenth Engineering Conference to be held in Houston, Tex., in the Fall. The Chemical Engineering and Corrosion Committees will sponsor the following papers:

1. "Properties and Analysis of Inorganic Pulping Solutions," by R. P. Whitney, S. T. Han, R. E. Kesler, and R. S. Couciere, Institute of Paper Chemistry, Appleton, Wis.
2. "Five Years' Investigation of Digester Corrosion," by N. Shoumatoff, West Virginia Pulp & Paper Co., New York, N. Y., and H. O. Teeple, International Nickel Co., New York, N. Y.

Dinner, Thursday evening, at the Engineering Division Conference

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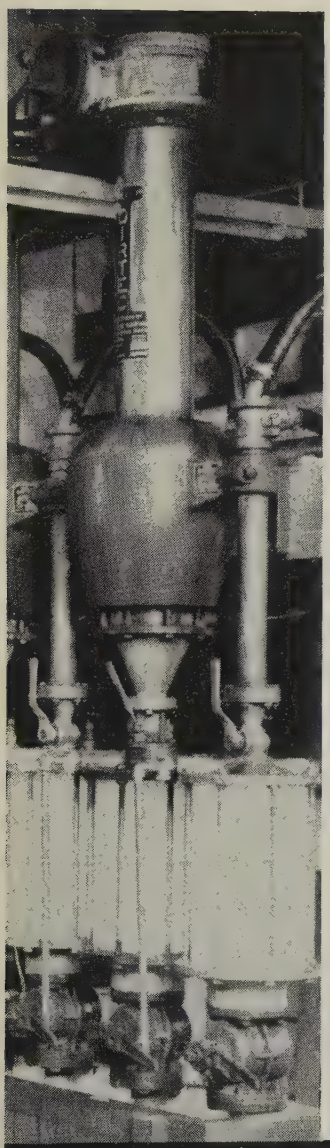

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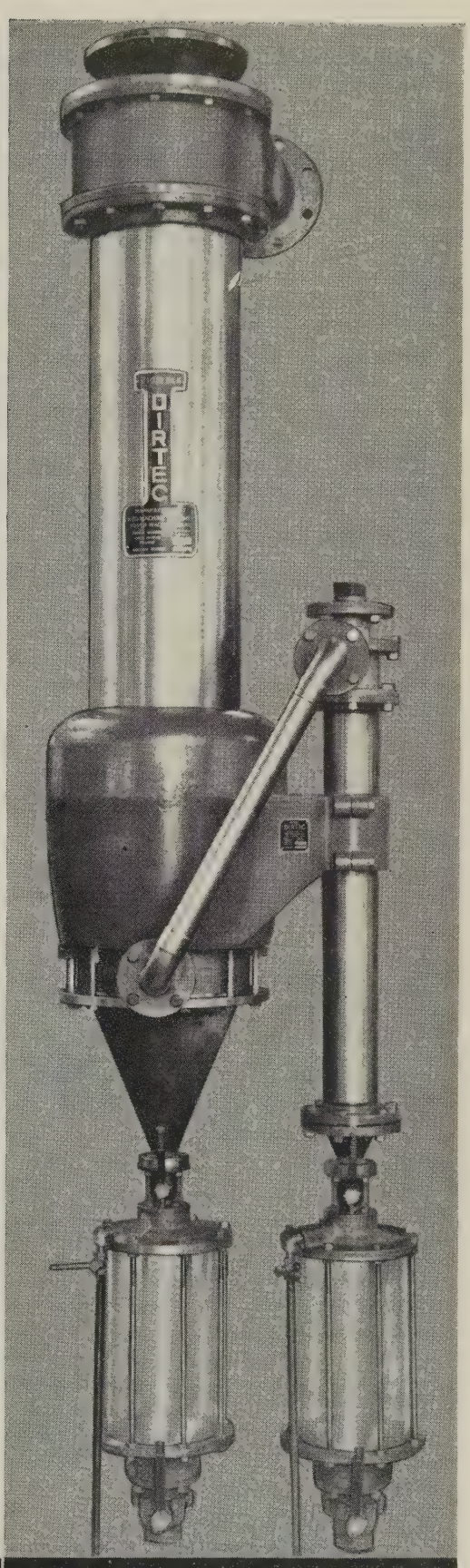

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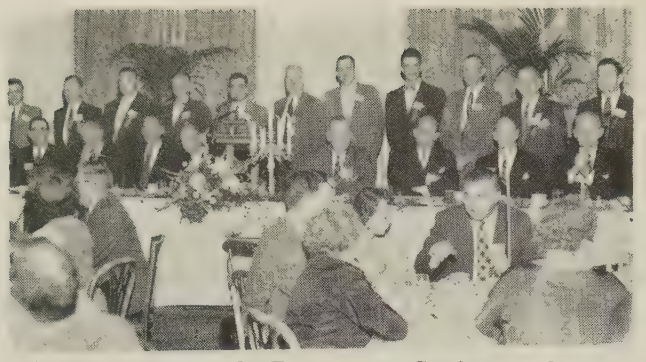


Speakers table at the Engineering Conference dinner

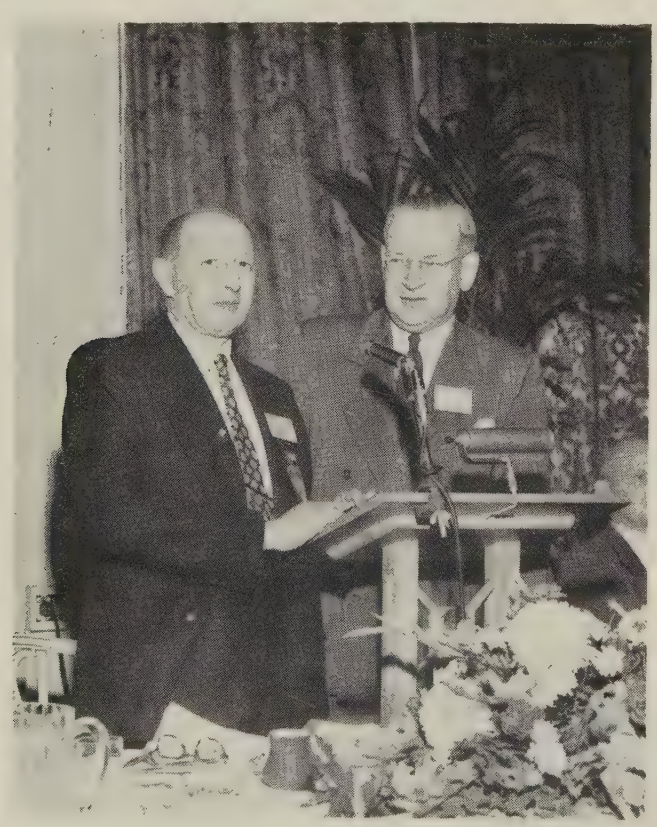
J. D. Lyall and H. W. Prentis, Jr., Armstrong Cork Co., and C. J. Sibler

Industrial Engineering and Materials Handling

At the Engineering Conference held in Philadelphia, the Materials Handling Committee was broadened in scope and is now known as the Industrial Engineering and Materials Handling Committee. This committee will cover the traditional industrial engineering fields such as methods improvements, layout of equipment in the plant, time and motion study, job evaluation, economic analysis, and will also develop interest in the industrial engineering phase of the new and rapidly developing areas such as operation research and automation.

The new committee, under the chairmanship of J. M. MacBrayne, chief industrial engineer of the Union Bag & Paper Corp., is desirous of enlisting the interest of those in the industry in this committee's activities, especially those who are doing industrial engineering work. It is suggested that anyone interested in learning more about the activity of this committee, get in touch with Mr. MacBrayne or the other members of the committee who are listed below.

J. M. MacBrayne, Union Bag & Paper Corp., Box 570, Savannah, Ga.
H. A. Stoess, Jr., Fuller Co., Catasauqua, Pa.
W. R. McNally, Link-Belt Co., Pittsburgh, Pa.
A. E. Drew, Southland Paper Mills, Lufkin, Tex.
Don Luebke, Marathon Corp., 710 Kinzie Court, Menasha, Wis.
J. O. Starkweather, Great Northern Paper Co., Millinocket, Me.
Fred Helverson, Crown Zellerbach Corp., 343 Sansome St., San Francisco, Calif.
W. A. McKenzie, Simpson Logging Co., 822 Turner Ave., Shelton, Wash.
H. F. Parker, New York & Pennsylvania Co., Lock Haven, Pa.
C. E. Patch, 862 Park Square Building, Boston 16, Mass.
A. P. Schnyder, Ebasco Services, Inc., 146 Cherry Lane, Teaneck, N. J.



C. J. Sibler, West Virginia Pulp & Paper Co.; Chairman, Engineering Division and G. H. Pringle, The Mead Corp., President of TAPPI

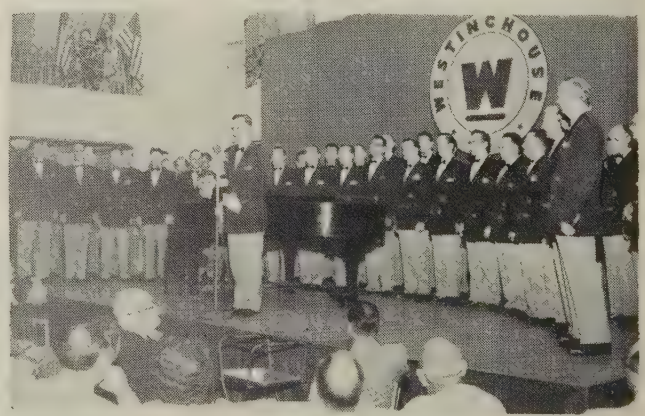
Industrial Waste Conference

The fourth annual Southern Municipal and Waste Conference will be held on March 31 to April 1, 1955, at the College of Engineering, Duke University, Durham, N. C. This conference is organized jointly by Duke University, University of North Carolina, and North Carolina State College.

Ninth Engineering Conference

The Ninth Engineering Conference of the Technical Association was held at the Benjamin Franklin Hotel in Philadelphia, Pa., on Oct. 18–21, 1954. There were 552 persons registered in attendance. This was the second time that the conference was held in the Quaker City.

Digests of many of the papers presented were published in an earlier issue of *Tappi* and the complete papers will be published at an early date.



Westinghouse Male Chorus

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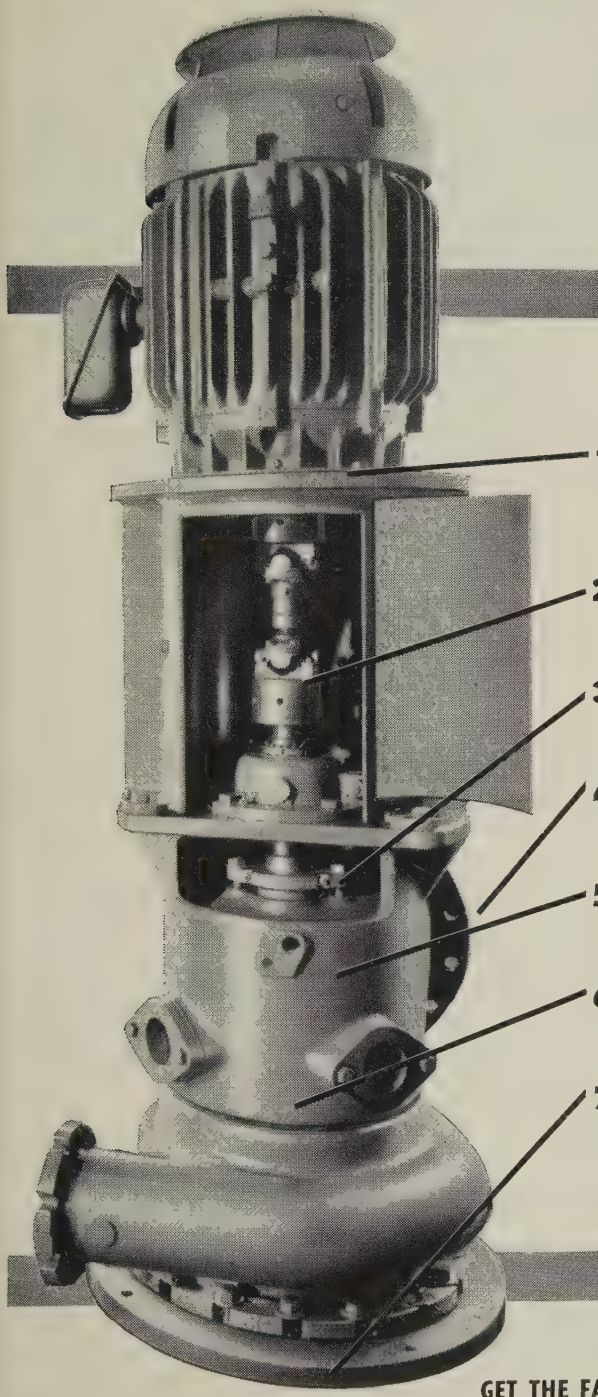

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A-C ALLIS-CHALMERS

ALLIS-CHALMERS

Mill Planning and Economics Committee luncheon

This report will merely round up some of the highlights of the program exclusive of the technical program.

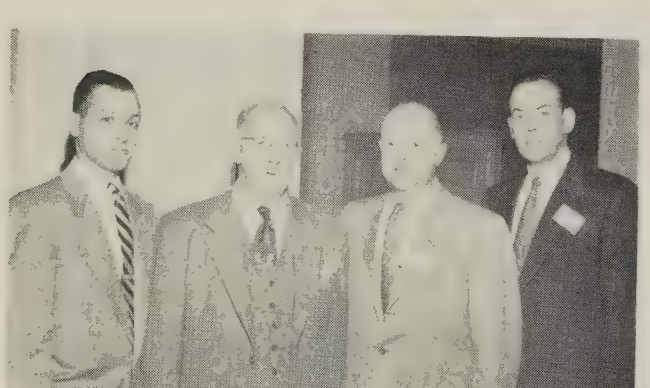
Social Evening

On Tuesday evening, October 19, the delegates were entertained at a reception sponsored by the allied industries in the Delaware Valley region. Following the reception there was a dinner, during which Charles J. Sibler of the West Virginia Pulp & Paper Co., New York, N. Y., was chairman and W. D. Harrison of the Riegel Paper Corp., Milford, N. J., was toastmaster.

Mr. Sibler introduced members of the Local Arrangements Committee who were responsible for the planning and preparation of the conference. The chairman of the local committee was J. C. Harper, Downingtown Mfg. Co., Downingtown, Pa. Edward J. Albert of the Thwing-Albert Instrument Co. was co-chairman and adviser. Henry S. Dimmick of SKF Industries, Inc. was secretary-treasurer. The hotel arrangements were taken care of by J. R. Curtis of the Scott Paper Co. William Kurlish of the General Electric Co. was responsible for the social arrangements. The mill visits were handled by R. C. Ridings of the Container Corp. of America. Emerson R. Glauner of the Downingtown Mfg. Co. was in charge of publicity. W. D. Harrison of the Riegel Paper Corp. was in charge of sponsor's activities, and W. H. Taylor of Allis-Chalmers Mfg. Co. handled the registration details.

Mr. Harrison, toastmaster, introduced the feature speaker, James Q. du Pont of E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., whose topic was "We're Working While Rome Burns." Mr. du Pont's address appeared in the November issue of *Tappi*.

A special attraction in the entertainment were the selections sung by the Westinghouse Male Chorus.



Steam and Power Session speakers: L. Copian, H. Hansen, W. M. Wyburn, R. J. Chapman

Steam and power discussion group. Seated: J. J. Radusan, F. G. Ely, C. L. Noll; Standing: R. V. Knapp, D. C. Edminston, N. H. Mailhos

Engineering Division Luncheon

The Engineering Division luncheon was held on Wednesday, October 20. Mr. Sibler presided as chairman.

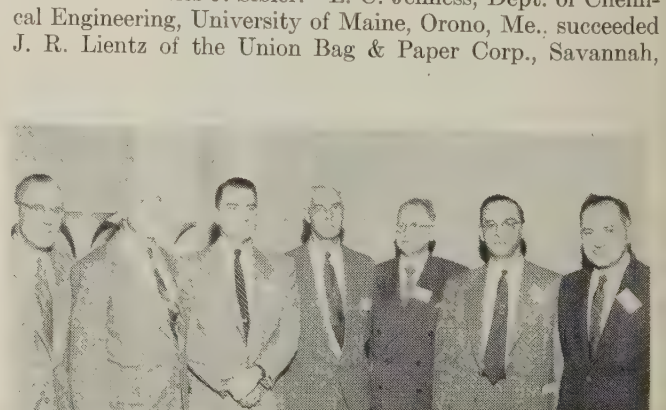
The guest speaker was H. W. Prentis, Jr., chairman of the board of the Armstrong Cork Co., Lancaster, Pa. His topic was "Industrial Progress of the Future—A Challenge to Top Management."

Chairmen and Secretaries Dinner

On Wednesday evening, October 20, the chairmen and the secretaries of the committees of the Engineering Division were the guests at a dinner as the guests of the Johns-Manville Corp., which was arranged by J. W. Hemphill of that company. Mr. Hemphill is chairman of the Engineering Data Sheets Committee and was a past general chairman of the division. Reports were made by all committee chairmen and plans for the 1955 conference were discussed.

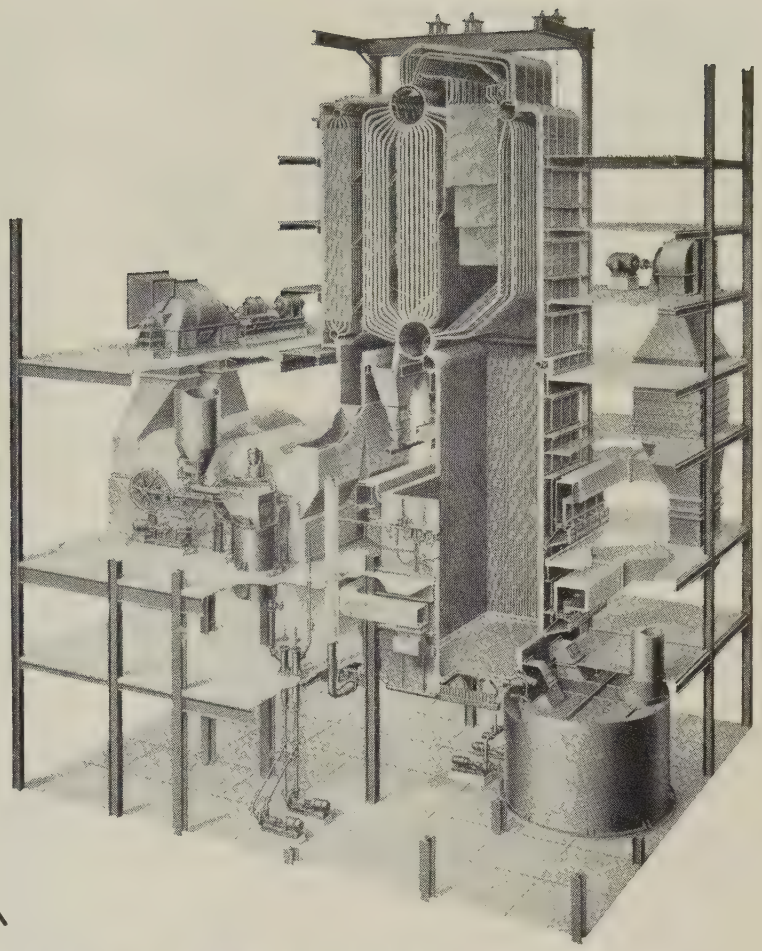
At this meeting two new committees in the division were announced: Corrosion Committee with S. J. Baisch of the Thilmany Pulp & Paper Co., Kaukauna, Wis., as chairman (this committee is an expansion of the previous Digester Corrosion Subcommittee of the Chemical Engineering Committee; its scope will be wider than that of the subcommittee); Industrial Engineering and Materials Handling Committee with J. M. MacBrayne of the Union Bag & Paper Corp., Savannah, Ga., as chairman.

The new officers appointed were: John D. Lyall of the Armstrong Cork Co., Lancaster, Pa., as general chairman succeeded Charles J. Sibler. L. C. Jenness, Dept. of Chemical Engineering, University of Maine, Orono, Me., succeeded J. R. Lientz of the Union Bag & Paper Corp., Savannah,



Mill and planning and economics discussion group: Allen Hyer, H. G. Ingraham, J. A. McPherson, R. G. Seip, S. Grimnes, P. A. Forni, and M. C. Celli

THE
C-E RECOVERY UNIT



it's ahead AUTOMATICALLY

Yes—the C-E Recovery Unit *is* ahead automatically because now it is available with automatic controls that take the guesswork out of recovery unit operation. While combustion controls, flow regulators and the like have long been standard equipment on many power boiler installations, their adaptation to the special problems involved in the burning of black liquor have been an elusive goal. Their successful application to the C-E Recovery Unit is now a service-proved fact.

By accurately and automatically adjusting the flow of air to the flow of fuel in just the right proportions, the C-E Recovery Unit has a sensitive response to change in black liquor flow—a response very difficult to duplicate through manual means.

The result?—More efficient black liquor combustion, less combustible matter in flue gas and more steam per ton of black liquor solids burned. This means, of course, an attendant reduction in steam costs.

Another equally important result is that the operator is no longer required to perform the tedious and time-consuming task of trying—sometimes not too successfully—to balance the air flow against an ever-changing black liquor supply. Relieved of this assignment, his time is available for other duties.

The application of automatic control to the C-E Recovery unit is still one more indication of the continuing efforts on the part of C-E to make a good product better.

Other C-E Equipment — In addition to the C-E Recovery Unit, Combustion Engineering is in a position to furnish any type of boiler, fuel burning and heat recovery equipment for supplying the steam needs of the paper mill: flash drying and calcining equipment for the recovery of lime; and pressure vessels for digestion and process. Through this wide range of C-E products, the advantages of single-contract responsibility are available to your plant.

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Mill Maintenance and Materials Session, chairman and speakers: J. R. Upson, H. F. Parker, and E. J. Kehoe

Ga., as chairman of the Chemical Engineering Committee. J. Osborne of Bowaters Southern Paper Corp., Calhoun, Tenn., succeeded Ray W. Foster of the Champion Paper & Fibre Co., Canton, N. C., as chairman of the Electrical Engineering Committee. L. L. Mrachek of The Mead Corp., Kingsport, Tenn., succeeded George Hrubecky (deceased) and Hubert F. Parker, New York & Pennsylvania Co., Lock Haven, Pa., acting chairmen, as chairman of the Mill Maintenance and Materials Committee. Vincent F. Owens of Combustion Engineering, Inc., New York, N. Y., succeeded Jacob Gottlieb of Westinghouse Electric Corp., New York, N. Y., as secretary of the Steam and Power Committee.

It was announced that the Tenth Engineering Conference probably will be held in Houston, Tex., on Oct. 31 to Nov. 3, 1955.

Plant Visits

The fourth day of the conference, Thursday, Oct. 21, was devoted to mill and plant visits to the Scott Paper Co. mill at Chester, Pa., the General Electric Co. switchgear plant, and the Westinghouse Electric Corp. turbine plants in Philadelphia. An unusual number, more than 50% of the total number of persons registered, went on these visits.

About 220 TAPPI men were welcomed at the Scott Paper Co. mill by R. C. Mateer, vice-president of the company. Here, through arrangements made by J. R. Curtis, director of mechanical research and Lem Warner, asst. plant personnel manager, to tour the plant assisted by qualified guide.

At the Westinghouse plant a group saw two paper machine drive turbines on test, a 5000-hp. gas turbine on test, and turbine generator units, 1000 to 250,000 kw.

One hundred delegates who visited the switchgear plant of the General Electric Co. saw switchgear equipment for utilities, transportation, and industrial plants. Of special interest was the high capacity laboratory in the control building when the delegates saw centralized control and instrumentation equipment which indicates and records every electrical

Dinner meeting for Engineering Division committee chairmen and secretaries

phenomenon which proves or disproves the value of switchgear equipment performance under short-circuit conditions. For these devices 400 miles of wire reach out to every device within the laboratory. In a matter of seconds a fiber record of electrical phenomena that took place in a switchgear interrupting device during regular or short-circuit test is on the reading tables in the control room for observation.

Meet the Engineer

During the meeting Messrs. Lyall, Bloomquist, and Macdonald were interviewed on Station WFLN (FM) by T. H. MacCauley of the General Electric Co. in a program, "Meet the Engineer," sponsored by the Philadelphia Section of the American Institute of Electrical Engineers. Discussing the subject "What TAPPI Means to Me" the following discussion proceeded:

T. H. MacCauley: In conjunction with the Ninth Engineering Conference of The Technical Association of the Pulp and Paper Industry held in Philadelphia, "Meet the Engineer," sponsored by the Philadelphia Section of the American Institute of Electrical Engineers, is grateful for this opportunity to devote its radio program this evening and next Wednesday evening to the great art of papermaking.

For the record, this is Tom MacCauley, chairman of its Radio Committee.

History tells us that the art of papermaking goes a way back to the year of 123 B.C. when the Chinese made paper from the inner bark of the mulberry tree. It was a laborious manual task to cook the wood, couch the bark, and press it into sheets of finished paper. Today, millions of tons of paper and paperboard are used annually. This paper may be for our newspapers or more than 10,000 other varieties of paper and paperboard used in our homes and industry throughout the world. From the time we read the morning newspaper until we pick up the evening paper, the average person handles more paper than any other material.

Steam and Power Committee lunch

Hydraulics Committee luncheon

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Four issues of Paper & Paper Products Convention Daily are issued for the:

Annual meetings of both the American Paper & Pulp Association and Technical Association Pulp & Paper Industry held in February in New York City.

The APPA will be meeting at the Waldorf-Astoria on the dates of Feb. 21, 22, 23, 24. TAPPI will hold its annual convention concurrently at the Hotel Commodore.

Paper & Paper Products Convention Dailies are REAL newspapers. They give all the news, programs, events and general information of association meetings. They reach the thousands of paper men attending these important conventions. Daily on-the-spot service that is typical of Paper & Paper Products.

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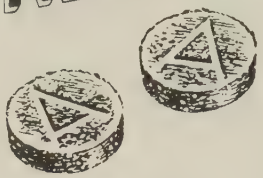

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Station WFLN(FM) broadcast. R. G. Macdonald, Secretary, TAPPI; J. D. Lyall, General Chairman-Elect of the Engineering Division; W. C. Bloomquist, General Secretary of the Engineering Division; and T. H. MacCauley, General Electric Co.

To meet today's enormous production requirements of millions of tons of paper means many engineering techniques in the process of production. One of the engineer's most important tasks in the paper industry is to unify his standards and technical vocabulary with engineers in other parts of the world. This is accomplished through the Technical Association of the Pulp and Paper Industry—better known as TAPPI.

The paper industry includes practically every engineering profession. Today we have with us representatives of many different engineering branches. One, the chemical engineer, is R. G. Macdonald, graduate of the Massachusetts Institute of Technology and having years of experience in the paper industry. Another is John Lyall, mechanical engineer and a graduate from Cornell University. The other representative is Walter Bloomquist, electrical engineer from the University of Minnesota.

Mr. Macdonald, can you give us some idea of the size of the paper industry?

R. G. Macdonald: Mr. MacCauley, the paper industry is now considered to be the fifth largest industry in the United States from the standpoint of invested capital. There are 22 million tons of paper manufactured each year and that amounts to about 300 lb. per man, woman, and child in this country. We might say that you do not use 300 lb. a year, but if we divide the production of the industry by the population of the country, we arrive at 300 lb. per person. There are 500 paper companies in the industry that operate 700 paper mills. A mill that was built most recently cost over 60 million dollars. The industry is constantly confronted with the great problem of obsolescence and this problem provides an opportunity for engineers to improve processes and products for the industry.

T. H. MacCauley: Walter Bloomquist, what do the engineers do at your conference?

W. C. Bloomquist: To answer that in detail would take quite a bit of time but I think I can quickly summarize our activities. First you might be interested in knowing the types of engineers we have at our meeting. To name a few we have electrical, electronics, mechanical, chemical, ventilating and heating, civil, hydraulics, steam and power, safety, industrial, and so forth. So you can see that we're very well represented engineering-wise.

The engineers come to discuss and try to solve the problems common to their industry. And they do this by personal discussion and exchange of information. They learn by talking things over with other engineers, finding out what they are doing and how they licked the problems, learning what's new, what the trends are, and so forth. The success of the paper industry is

Drying and Ventilating Committee luncheon

Materials Handling and Industrial Engineering Committee luncheon

based on the pre-exchange of ideas on technical and operating developments, and that's the engineer's job. I would like to point out that management appreciates the importance of their engineers and their need for this type of association. And to me, it's quite significant that practically every engineer here was sent by his company with all expenses paid.

T. H. MacCauley: John Lyall, are there good opportunities for engineers?

J. D. Lyall: Oh yes! There is no lack of opportunity in the paper business. The lack has been competent engineers for the opportunities available. The industry has always been looking for new methods, new materials, and there is no lack of ventured capital to accept risk on revolutionary projects. Further, the industry is always producing new and amazing products to broaden the use of paper. And, time in the industry is relatively stable and growth for engineers is unlimited as evidenced by the fact that many engineers now occupy top positions in the industry. One large company I know employs over 200 engineers, yet the industry is divided up into more than 700 mills with no one mill or one group of mills controlling the industry. This is a very healthy condition for one seeking opportunity.

T. H. MacCauley: Mr. Macdonald, I have another question for you to answer. Most of us think of paper in a limited way. I would say the average person can list about 10 different kinds.

R. G. Macdonald: That's quite true, Mr. MacCauley. I have asked many people to name them and they can name about that number. But actually, there are more than 10,000 kinds of paper all having special properties. There are more than 100 measurable properties of paper. Engineers are able to manipulate these properties to produce a particular kind of paper for a particular use. For example, a new paper may be needed for a vacuum cleaner bag. That must be very coarse and have very high tensile strength. The new applications of plastics in combination with paper are broadening the kinds and number of papers that are available to the public.

T. H. MacCauley: As chairman of the Radio Committee, may I extend our thanks to you Mr. Macdonald, you John Lyall, and you too, Walter Bloomquist. You have certainly brought into focus a greater appreciation of the wonders of life which we so often take for granted. I am sure our listeners know that TAPPI means to all of us. Most of us seldom realize or give any thought to the millions of cords of wood which must be changed into paper to meet the annual average requirements of each and every man, woman, and child of 160 millions of people in America. This is a real task made possible by the indispensable man—the engineer.

Electrical Engineering Committee luncheon

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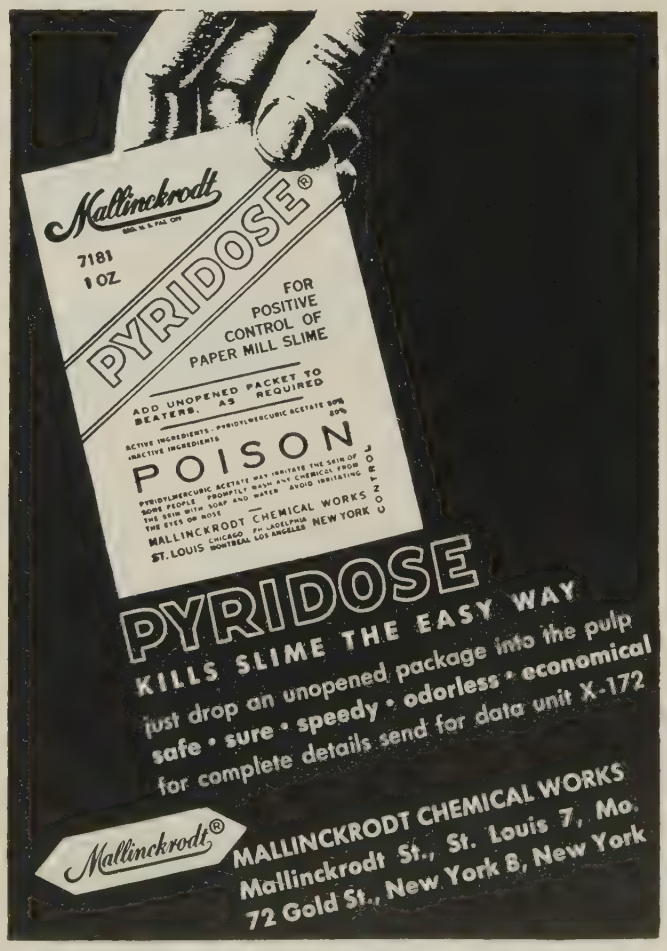
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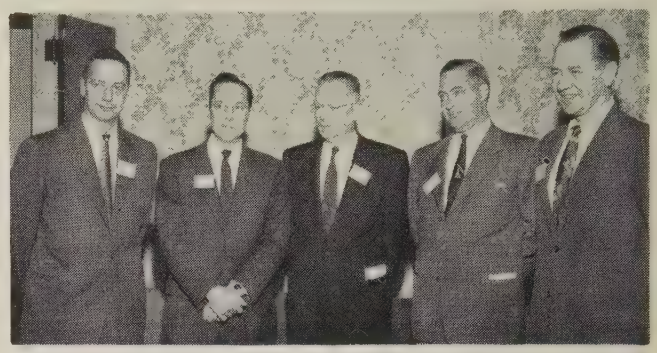
TAPPI Medal Awarded to Vance P. Edwardes

The twenty-third TAPPI Medal will be awarded to Vance P. Edwardes, consultant, Corinth, N. Y., at the annual luncheon of the Technical Association of the Pulp and Paper Industry, Thursday, Feb. 24, 1955.



Digester corrosion discussion group: L. A. de la Grange, H. O. Teeple, W. B. Parker, J. R. Lientz, and Nicholas Shoumatoff

The presentation will be made by Clark C. Heritage of the Weyerhaeuser Timber Co., Tacoma, Wash., on behalf of the Association.

Mr. Edwardes was born in San Francisco, Calif. After two years at the University of Arizona, he attended and graduated from the University of California in Berkeley.

Following graduation he spent a few years working as a mine smelter chemist and as a chemist and sulphite mill foreman for the Crown Willamette Paper Co., West Linn, Ore., and later, for the Interlake Pulp & Paper Co., at Appleton, Wis.

During and after World War I he was employed by the Forest Products Laboratory, Madison, Wis., where he worked on various research and development projects. In 1929 he joined the International Paper Co., in New York City, as sulphite pulping consultant, where he had supervisory charge of the sulphite pulping operations of the mills in the United States and Canada.

In 1935 he became sulphite superintendent at the Hudson River mill of the company in Palmer, N. Y., where he remained until he retired in 1949.

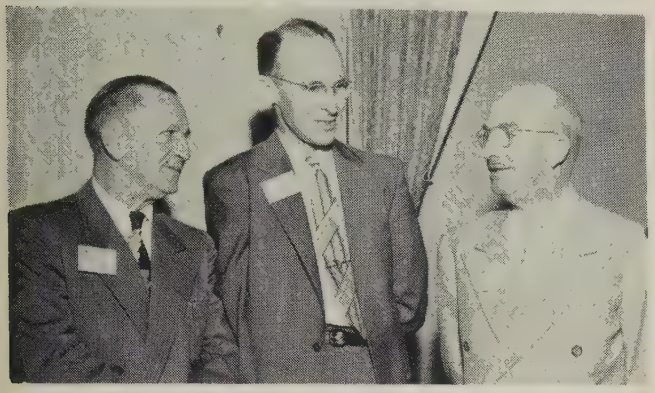
Mill Maintenance and Materials Committee luncheon

Between 1920 and 1953 Mr. Edwardes published over 30 articles in various trade magazines and was granted several patents. Since retirement from the International Paper Co., Mr. Edwardes has been actively engaged in consulting work. In 1944 and 1945 he was president of the Technical Association of the Pulp and Paper Industry.

Pulp Purification Sessions

The Pulp Purification Committee is preparing two 3-hour sessions for the 1955 Annual Meeting program.

A symposium on chlorine dioxide bleaching will be held on Tuesday morning, February 22. Following papers on



Hydraulics Session speakers, L. C. Jenness, R. C. Durst, and K. J. Mackenzie

chlorine dioxide and safety, and the effect of variables on chlorine dioxide bleaching of sulphate pulp, a panel discussion will be presented by members from mills now using chlorine dioxide.

On Tuesday afternoon the subject of peroxide bleaching will be discussed. Papers will be presented on the peroxide bleaching of western, southern, and northern kraft, and will be followed by a panel discussion. Complete titles and authors of all papers will be found in the program published elsewhere in this issue.

Corrugated Containers Session

Three 3-hour technical sessions are being prepared for the Annual Meeting program being sponsored by the TAPPI Corrugated Containers Committee. Full titles and authors of the papers to be presented are shown in the complete program published elsewhere in this issue.

On Wednesday morning, February 23, papers will be presented on a variable-speed drive, starches in corrugating and corrugator design, followed by a panel discussion on the design of corrugators. W. D. Arbuthnot, Fibre Board Container Corp., Richmond, Va., will be chairman of this session.

Engineering Research and Machine Design Committee luncheon

T. C. West, Southwest Corrugated Box Co., Forth Worth, Tex., will be chairman of the Wednesday afternoon session when a résumé of the recent printer-slotter questionnaire will be given, followed by papers on raw material control, printing die practices on the printer-slotter, and research into creaser profiles.

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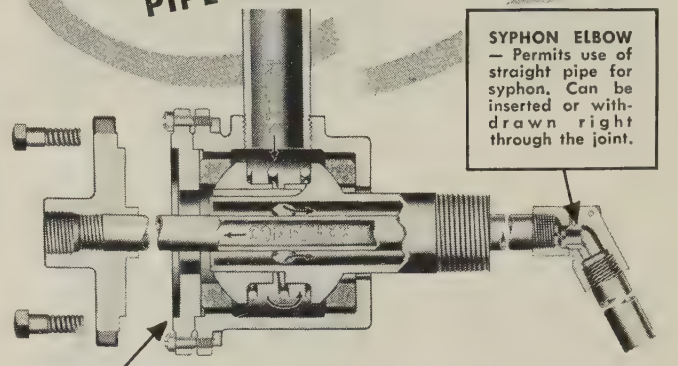
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Engineering Research and Machine Design Session speakers: R. G. Quinn, M. N. Davis, J. T. Roberts, and L. A. Moore

Mill Planning and Economics Session speakers: H. G. Ingraham, J. A. McPerson, P. A. Forni, and E. K. Murphy

On Thursday morning, February 24, F. D. Long, Container Corp of America, Chicago, Ill., will be moderator of a panel which will hold an open forum on box shop problems. Members of the panel will include: W. F. Ward, F. X. Hooper Co., C. F. Lovely, Philadelphia Quartz Co., E. B. Seeger, S. M. Langston Co., J. C. Neuhauser, F. X. Hooper Co., H. Blacker, Blacker Printing Ink Co., F. Lowry, Universal Corrugated Box Machinery Co., J. Bliss, Bostitch, Inc., T. C. West, Southwest Corrugated Box Co., C. F. Skiner, American Boxboard Co.

Chemical Engineering Committee luncheon

TAPPI Annual Luncheon Speaker

The featured speaker at the annual luncheon of the Technical Association of the Pulp and Paper Industry on Thursday, Feb. 24, 1955, will be Clarence Francis, director and formerly chairman of the board of General Foods Corp., New York, N. Y. At present Mr. Francis is carrying out special assignments for President Eisenhower.

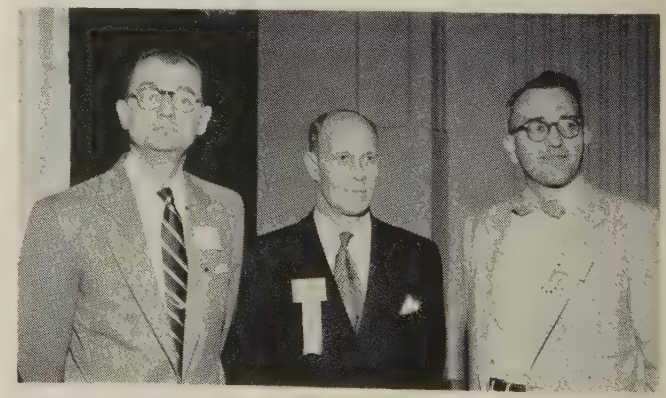
Mr. Francis was born in Staten Island, N. Y., in 1888 and graduated from Amherst College in 1910. Over the years he was employed by the Corn Products Refining Co., Ralston Purina Co., and the Postum Co., which entered into the combination now known as the General Foods Corp. where he became vice-president in charge of sales and later board chairman. He is a director of The Mead Corp., Air Reduction Co., Chemical Bank & Trust Co., and the Northern Pacific R.R.

Drying and ventilating discussion panel

Statistics Sessions

Two 3-hour sessions on Statistics are planned for the Annual Meeting program. Sponsored by the TAPPI Statistics Committee under John F. Langmaid, Jr., S. D. Warren Co., Cumberland Mills, Me., chairman, the sessions will be held on the morning and afternoon of Wednesday, February 23.

Materials Handling and Industrial Engineering Session speakers: J. M. MacBrayne, L. Cirillo, and E. J. Kusnierek



Drying and Ventilating Session: C. A. Young, chairman; J. C. Harper and L. G. Janett, speakers

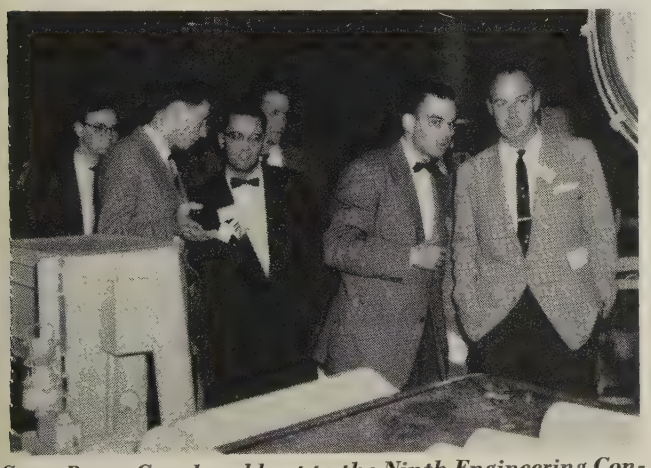
Master control board at the switchgear laboratory of the General Electric Co., from which all tests are controlled

The morning session will be a panel discussion on "Using Statistics in the Paper Industry," with Geoffrey Beall, University of Connecticut, Storrs, Conn., C. A. Bicking, Office of the Chief of Ordnance, Washington, D. C., and R. T. Trelfa, Watervliet Paper Co., Watervliet, Mich., as panel members.

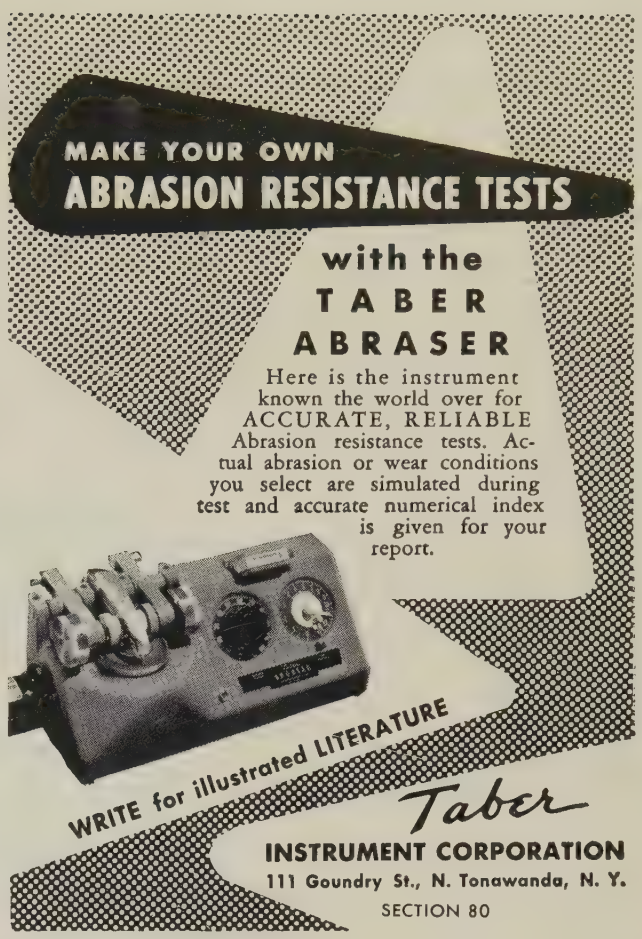
Joseph M. Juran, consultant, Tuckahoe, N. Y., perhaps the best known quality engineer in the United States, will open the afternoon session with a talk on "Installing a Quality Control Program." L. C. Paulson, Minnesota and Ontario Paper Co., Minneapolis, Minn., will present a paper entitled "Statistical Quality Control in the Paper Industry," and F. C. Hartwell, Peter J. Schweitzer, Inc., Lee, Mass., will talk on "The Development of an Acceptance Plan for the Property—Thickness."

Sixth Coating Conference

The Sixth TAPPI Coating Conference will be held at the Statler Hotel, Cleveland, Ohio, on May 24–28, 1955. The technical program will feature "Pigments" and "Graphic Arts." There will be an exhibit of coating pigments and pigment processing equipment. Local arrangements are being handled by the TAPPI Lake Erie Section. Plant visits will be made to the Glidden Co. and the American Greeting Card Co. plants in Cleveland.



Scott Paper Co. played host to the Ninth Engineering Conference of the Technical Association of the Pulp and Paper Industry on Oct. 21. Approximately 220 TAPPI men toured the mill in morning and afternoon sections after being welcomed to the company by Executive Vice-president R. C. Mateer and Plant Manager John McNichol. Here through the arrangements of Ray Curtis, Director of Mechanical Research, qualified guides, under the direction of Assistant Plant Personnel Manager Len Warner, handled the visitation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The Arrangements Committee for the Sixth Coating Conference comprises the following:

General Chairman: J. D. Davis, The Mead Corp., Chillicothe, Ohio

Program Chairman: J. E. Webber, St. Regis Paper Co., Deferiet, N. Y.

Panel Discussion: J. W. Swanson, The Institute of Paper Chemistry, Appleton, Wis.

Publicity: L. H. Silvernail, The Dow Chemical Co., Midland, Mich.

Exhibits: R. N. Thompson, Calgon, Inc., Pittsburgh, Pa.

Local Arrangements and Social Program: William Schoenberg, Lord & Schoenberg, Cleveland, Ohio; and J. F. Richmond, Ace Electrotype Co., Cleveland, Ohio

Graphic Arts Committee: C. A. Morton, West Virginia Pulp & Paper Co., Chicago, Ill.

Luncheon Speaker: G. K. Ferguson, Watervliet Paper Co., Watervliet, Mich.

Second Mechanical Pulping Conference

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of the

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PERSONAL MENTION

Items About New and Old Tappimen

New TAPPI Members

Philippe Aghion, Technical Manager, Papeteries de Mauduit, Quimperle, Finistere, France. Attended Columbia University.

F. Mark Allen, Chief Chemist, East Texas Pulp & Paper Co., Evadale, Tex., a 1950 graduate of Linfield College.

Roland L. Allen, Jr., Engineer, J. E. Sirrine Co., Greenville, S. C., a 1950 graduate of Clemson College.

Maung Mai Aung, student, New York State College of Forestry, Syracuse, N. Y.

John R. Ayres, Sales Engineer, E. D. Jones & Sons Co., Pittsfield, Mass.

Tronie A. Bailey, Technical Service Representative, Keever Starch Co., Columbus, Ohio, a 1950 graduate of Purdue University.

Lothrop B. Bartlett, Superintendent, Great Northern Paper Co., Madison, Me., a 1925 graduate of Northeastern University.

Raymond I. Bashford, Jr., Chemist, E. I. du Pont de Nemours & Co., Inc., Newport, Del., a 1950 graduate of Syracuse University with a Ph.D. degree.

Robert F. Black, Sales Manager, The Keever Starch Co., Columbus, Ohio.

Bill D. Bottonfield, Junior Engineer, The Mead Corp., Chillicothe, Ohio, a 1952 graduate of Ohio State University.

Joseph E. Boyle, Director, Technical Service Dept., The Hubinger Co., Keokuk, Iowa, a 1941 graduate of Iowa Wesleyan College.

Paul L. Breyfogle, Technical Assistant, A. E. Staley Mfg. Co., Decatur, Ill., a 1942 graduate of Purdue University.

Dale Bumstead, Jr., President, Bumstead-Woolford Co., Seattle, Wash., a 1921 graduate of Cornell University.

Robert R. Buss, Sales Representative, Hercules Powder Co., Kalamazoo, Mich.

Richard D. Campbell, Assistant Manager, Corrugated Fibre Container Pty., Ltd., North Melbourne, Australia.

George T. Cartier, Chemist, Quaker Chemical Products Corp., Conshohocken, Pa., a 1949 Graduate of Haverford College.

Richard G. Clark, Physicist, The Gardner Board & Carton Co., Middletown, Ohio, a 1953 graduate of Oberlin College.

Richard J. Collins, Jr., Chief Inspector, The Sandy Hill Iron & Brass Works, Hudson Falls, N. Y., a 1926 graduate of the University of Notre Dame.

William J. Cotton, Owner and Manager, W. J. Cotton Laboratories, Milwaukee, Wis., a 1911 graduate of the University of Wisconsin.

Paul I. Coughlin, Student, University of Maine, Orono, Me.

John Crawford, Midwest Representative, Brown Co., Berlin, N. H., a 1941 graduate of Tufts College.

Frederick B. Curtenius, Secretary-Treasurer, Kalamazoo Paper Co., Kalamazoo, Mich., a 1930 graduate of the University of Michigan.

Carlos G. Marinho da Cruz, Chief Engineer, Celuloses do Guadiana, S.A.R.L., Lisbon, Portugal, a 1938 graduate of the University of Grenoble.

Joseph O. Danko, Jr., Mechanical Engineer, Greenwood Engineering Co., Baltimore, Md., a 1948 graduate of Cornell University.

Raymond R. Dirksen, Sales Engineer, Dynamatic Div., Eaton Mfg. Co., Kenosha, Wis., a 1947 graduate of Michigan College of Mining and Technology.

Warren R. Engel, Student, Western Michigan College, Kalamazoo, Mich.

George N. Ferguson, Head, Process and Products Development, Buckeye Cotton Oil Co., Memphis, Tenn., a 1938 graduate of New York University with a Ph.D. degree.

Edwin F. Fischer, Jr., Technical Director, Gilbert Paper Co., Menasha, Wis., a 1938 graduate of the University of Wisconsin.

Robert Gacon, Application Engineer, Cie. de St. Gobain Antony (Seine) France, a 1946 graduate of the College of Industrial Chemistry, Lyon.

Joseph W. Gary, Quality Control, Great Southern Box Co., Inc. of Mississippi, Jackson, Miss., a 1949 graduate of the University of Mississippi.

Warren T. Gauld, Foreman, Recovery Plant, S. D. Warren Co., Westbrook, Me., a 1951 graduate of Harvard University.

Thomas S. Harris, Jr., Quality Control Engineer, The Buckeye Cellulose Corp., Foley, Fla., a 1949 graduate of Georgia Institute of Technology.

Ernest E. Hembree, Head, Cellulose Products Service, Buckeye Cotton Oil Co., Memphis, Tenn., a 1928 graduate of the University of South Carolina.

Martin L. Hook, Assistant Plant Engineer, Escanaba Paper Co., Escanaba, Mich., a 1949 graduate of Purdue University.

Charles A. Jacoby, Operating Engineer, West Virginia Pulp & Paper Co., Luke, Me., a 1948 graduate of Carnegie Institute of Technology.

Lactance A. Jarvis, Technical Sales Representative, Wyandotte Chemicals Corp., Wyandotte, Mich., a 1943 graduate of Michigan State College.

Arthur H. Johnson, Production Supervisor, Western Printing & Lithographing Co., Racine, Wis.

Kiyoshi Kawase, Research Assistant, Hokkaido University, Sapporo, Japan, a 1946 graduate of the College of Agriculture.

Bernard G. Klowak, Mill Control Chemist, Marathon Corp. of Canada Ltd., Marathon, Ont., Canada, a 1949 graduate of the University of Manitoba.

Stanislav Koselt, Technical Manager, Touarna Dokumentnega in Kart, Papirta, Radece, Yugoslavia, a 1929 graduate of the Technical College.

Enrique J. C. Lampe, Manager, F.A.I.P. S.R.L., Caseros. F.C.N.G.S., Argentina.

John A. Lenau, Sales, Keever Starch Co., Columbus, Ohio.

Charles W. Lillie, Field Representative, National Aluminate Corp., Chicago, Ill., a 1942 graduate of the University of Michigan.

Joseph E. McCaffrey, Jr., Student, North Carolina State College, Raleigh, N. C., a 1953 graduate of Marquette University.

James S. McCartney, President, Northland Chemical Services, Inc., St. Paul, Minn., a 1940 graduate of the University of Minnesota.

Reginald D. Merrill, Executive Engineer, Stone Container Corp., Chicago, Ill., a 1929 graduate of the University of Illinois.

John H. Morris, Paper Mill Tour Foreman, Macon Kraft Co., Macon, Ga.

Thomas J. Neel, Technical Sales, The Keever Starch Co., Columbus, Ohio, a 1937 graduate of the University of Alabama.

Frederick J. Newberg, Supervisor, Coating Dept., Eastman Kodak Co., Rochester, N. Y., a 1936 graduate of the University of Michigan.

Paul S. O'Brien, Sales and Technical Representative, Socony Paint Products Co., Beaumont, Tex., a 1922 graduate of Massachusetts Institute of Technology.

John F. O'Flaherty, Technical Assistant, Alliance Paper Mills Co. Ltd., Georgetown, Ont., Canada, a 1953 graduate of Niagara University.

Toyohiko Ohta, Director, Institute for Textile-Chemical Research, Osaka-Fu, Japan, a 1926 graduate of Tokyo Imperial University.

Antonio Plana, Project Engineer, National Industrial Institute, Madrid, Spain, a 1952 graduate of the College of Industrial Engineering, Barcelona.

Michael Pope, Consulting Engineer, New York, N. Y., a 1944 graduate of the College of the City of New York.

Robert C. Ridings, Power Superintendent, Container Corp. of America, Philadelphia, Pa., a 1947 graduate of the University of Pennsylvania.

Willy H. Rau, Secretary and Treasurer, Hygrotester, Inc., Brooklyn, N. Y.

Arthur J. Roemer, Mechanical Engineer, Appleton Coated Paper Co., Appleton, Wis., a 1935 graduate of Lawrence College.

Frederick J. Rosebush, Chemical Engineer, Buffalo Electro-Chemical Co., Buffalo, N. Y., a 1949 graduate of the University of Maine.

John W. Rouse, President, John W. Rouse Construction Corp., Gouverneur, N. Y.

Theodore B. Russell, Plant Engineer, The West Jersey Paper Mfg. Co., Camden, N. J.

Alberto P. Seguin, Technical Director, Celubagaco Industriale Comercio S. A., Rio de Janeiro, Brazil, a 1943 graduate of the National University, Lima, Peru.

James H. Smith, Sales Engineer, The Glidden Co., Cleveland, Ohio, a 1936 graduate of the University of Texas.

Peter T. Spottiswoode, Assistant Technical Director, Sherman Paper Products Corp., Newton Upper Falls, Mass.

Harald Stokland, Research Chemist, A/S Fagertum Fabr., and A/S Sundland Papirfabr., Drammen, Norway, a 1944 graduate of the Technical University of Norway.

Walter B. Sullivan, Jr., Student, New York State College of Forestry, Syracuse, N. Y.

Frederic H. Sutton, Salesman, Artisan Metal Products, Inc., Waltham, Mass.

Charles A. Swerdlove, Assistant to Production Manager, Robert Gair Co., Inc., New York, N. Y., a 1945 graduate of Cornell University.

Takeo Takasugi, Chief, Engineering Dept., Okayama Paper Mill Co., Okayama-shi, Japan, a graduate of Meiji Technical College.

Kenji Takeuchi, Director, Takasaki Pulp & Paper Co. Ltd., Tokyo, Japan, a 1933 graduate of Nagaoka Higher Technical School.

Donald B. Taylor, Packaging Engineer, Hudson Pulp & Paper Corp., New York, N. Y., a 1948 graduate of Babson Institute.

Aoki Teiji, Mill Manager, Honshu Paper Mfg. Co. Ltd., Tokyo, Japan, a 1926 graduate of Tokyo Technological College.

John W. Tester, Student, North Carolina State College, School of Forestry, Raleigh, N. C.

Tore E. Timell, Honorary Lecturer, McGill University, Montreal, P. Q., Canada.

Saul Ulano, General Manager, Holyoke Bar Co., Holyoke, Mass., a 1950 graduate of the Lowell Institute School.

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William J. Verross, Superintendent, Experimental Pulp Mill, West Virginia Pulp & Paper Co., Covington, Va., a 1943 graduate of Ohio State University.

John F. Whalen, Technical Director, Combined Locks Paper Co., Combined Locks, Wis., a 1947 graduate of Purdue University.

Errington A. Whiteford, President, Whiteford Paper Co., Inc., New York, N. Y.

M. J. Witkowski, Quality Control Dept., National Gypsum Co., Medicine Lodge, Kan., a 1943 graduate of Loyola College.

Robert E. Witt, Chief Engineer, John W. Rouse Construction Corp., Gouverneur, N. Y., a 1939 graduate of the University of Oklahoma.

Takao Yamada, Manager, Research Section, Sanyo Pulp Co. Ltd., Iwakuni Mill, Yamaguchi, Japan, a 1931 graduate of Kyoto Imperial University.

Toshio Yamamoto, Director of Tsuruga Rayon Factory, Toyo Cotton Spinning Co. Ltd., Osaka, Japan, a 1926 graduate of The Imperial University.

TAPPI Notes

E. E. Archibald is now Assistant General Manager of Potlatch Forests, Inc., Lewiston, Idaho.

Ellis T. Anderson, formerly Plant Manager of Arkell & Smith, is now Sales Engineer for the Smith & Winchester Mfg. Co., South Windham, Conn.

Bruce Armstrong is now Technical Director of Jackson & Church Co., Saginaw, Mich.

David W. Baird, formerly of New York & Pennsylvania Co., is now a Chemist for the Oxford Paper Co., Rumford, Me.

Louis O. Barber, formerly General Superintendent of the Minerva Wax Paper Co., is now a Product Development Engineer for J. C. Baxter Co., Minerva, Ohio.

W. Francis Bathon is now Technical Director of the Elk Paper Co., Childs, Md.

Stanley Baughman, formerly of the Container Corp. of America, is now Plant Manager of O. B. Andrews Co., Knoxville, Tenn.

Seward M. Bazzler, formerly Student at Ohio State University, is now Product Engineer for the General Electric Co., Coshocton, Ohio.

Stuart I. Bergman, formerly of the Brown Co., is now Sales Engineer for the Gilman Paper Co., New York, N. Y.

R. W. Birch, formerly of the Union Bag & Paper Corp., is now an Engineer in the Technical Service Dept., West Virginia Pulp & Paper Co., Covington, Va.

James D. Brown, formerly of the Sutherland Refiner Corp., is now Sales Engineer for Jackson & Church Co., Saginaw, Mich.

Oevind Bryde, formerly Manager of Vestfos Cellulosefabrik, is now with A/S Greaker Cellulosefabrik, Greaker, Norway.

Marius Comps, formerly Manager of Soc. CENPA, is now a Consulting Engineer for Pessac (Gironde), France.

J. Ray Curtis is now Director of Mechanical Research for the Scott Paper Co., Chester, Pa.

Frank Duvall is now Assistant Chief Engineer of Shartle Div., Black-Clawson Co., Hamilton, Ohio.

Francis J. Early, formerly of APW Products, Inc., is now in the Army at Ft. Eustis, Va.

Henry T. Fisher, formerly of the Quebec North Shore Paper Co., is now Research Chemical Engineer for the Ontario Paper Co., Thorold, Ont.

Robert R. Forrest, formerly of the Great Northern Paper Co., is now Engineer with the Champion Paper & Fibre Co., Hamilton, Ohio.

John F. Hart is now Container Division Engineer for the Longview Fibre Co., Longview, Wash.

W. R. Haselton is now Manager of Manufacture of the Rhinelander Paper Co., Rhinelander, Wis.

William D. Haskell is now Assistant Sales Manager of the Dilts Div., Black-Clawson Co., Fulton, N. Y.

Gilbert L. Heath, Vice-President in Charge of Production of Scott Paper Co., is now with the Falls Paper & Power Co., Oconto Falls, Wis.

Donald E. Helleur, formerly Technical Associate at The Institute of Paper Chemistry, is now Technical Director of the Groveton Paper Co., Groveton, N. H.

Charles E. Hill is now Assistant Chief Engineer of the Pusey & Jones Corp., Wilmington, Del.

Herbert A. Hoffman, formerly Student at the New York State College of Forestry, is now in the U. S. Army.

Norbert Jansen is now Technical Director of the Nicolet Paper Co., W. De Pere, Wis.

Wayne E. Kendrick, formerly of the U. S. Army, is now with the Allied Paper Mills Co., Kalamazoo, Mich.

Donald H. Kincaid is now Chemical Engineer for the Minnesota & Ontario Paper Co., International Falls, Minn.

Glen D. King is now Assistant Resident Manager of the Crown Zellerbach Corp., West Linn, Ore.

Joseph L. Kubicka, formerly of the Container Corp. of America, is now General Superintendent of the John Strange Paper Co., Menasha, Wis.

John D. McCrystal, formerly General Manager of the Mt. Tom Div., Doeskin Products, Inc., is now a Consultant in Amherst, Mass.

Warren W. Machem is now Sales Manager of the Bagley & Sewall Corp. Div., Black-Clawson Co., Hamilton, Ohio.

Myron P. Marander, formerly of the Dow Chemical Co., is now in the Research & Development Div., Fibreboard Products, Inc., Antioch, Calif.

Rutger Martin-Lof, formerly of A/B Stateus Skogsindustrier, is now Managing Director of Skogsagarnas Cellulosa A/B, Stockholm, Sweden.

George W. Mead, II is now Director of Product Development for the Consolidated Water Power & Paper Co., Wisconsin Rapids, Wis.

Walter C. Miller is now Vice-President and Plant Manager of Coos Bay Pulp Co., Anacortes, Wash.

Lawrence A. Moore is now Chief Engineer of the Black-Clawson Co., Hamilton, Ohio.

Jack R. Murphy is now a Project Engineer for the Champion Paper & Fibre Co., Pasadena, Tex.

Edward H. Nunn has been transferred from the West Linn, Ore., mill to the Carthage, N. Y., mill of the Crown Zellerbach Corp. as Resident Manager.

Michael H. Ober, formerly of the Standard Paper Mfg. Co , is now a Chemist for the Camp Mfg. Co., Franklin, Va.

W. Malcolm Orchard, formerly of the St. Laurence Paper Corp., is now Sales Engineer for the Downingtown Mfg. Co., Downingtown, Pa.

Hugh C. Osborn, formerly of the General Dyestuff Corp., is now the West Coast representative of the Lockport Felt Co., Portland, Ore.

Robert W. Pattison, formerly President of Cellulose Pulp Products, Inc., is now Pulp and Paper Consultant for the Adell Chemical Co., Holyoke, Mass.

Robert J. Pelliccione, formerly Student of the Lowell Technological Institute of Massachusetts, is now Manufacturing Apprentice in the Research Div. of the International Paper Co., Glens Falls, N. Y.

Henry B. Pratt, Jr., formerly of the Puget Sound Pulp & Timber Co., is now Project Engineer for Stevenson & Rubens, Seattle, Wash.

H. E. Pratt is now General Superintendent for the Pejepscot Paper Div., Hearst Publishing Co., Brunswick, Me.

Charles J. Prawdzik is now Plant Manager of Interstate Container Corp., New Haven, Conn.

Geoffrey Pyner, formerly of the Whatakane Board Mills Ltd., is now Mill Chemist for the Tasmanian Board Mills, Ltd., Launceton, Tasmania.

George H. Rand is now Division Manager of the Northern Mills of the International Paper Co., Glens Falls, N. Y.

Douglas E. Read, formerly General Superintendent of the International Fibre Board & Masonite Co. of Canada, is now General Manager of Industrial Cellulose Research Ltd., Hawkesbury, Ont.

Edward H. Root is now Vice-President and General Manager of Black-Clawson (Canada) Ltd., Montreal, P. Q.

Seppo M. Saukkonen, formerly of Veitsilucoto O/Y, is now with the Metex Cooperative Corp., Helsinki, Finland.

J. L. Sommerville is now Chief Chemist of the Australian Newsprint Mills, Boyer, Tasmania.

William J. Sprau is now Production Manager of the National Gypsum Co., Buffalo, N. Y.

W. L. Stafford is now Chief Chemist of the Hercules Powder Co., Hopewell, Va.

Siegfried Studer, formerly of Balsthal Paper Mills, is now with Cellulose-fabrik Attisholz A/G, Post Luterbach (Solerui), Switzerland.

Harry M. Sutcliffe, formerly of the Celotex Co., is now Pulp Mill Superintendent of Valentine Pulp & Paper Co., Lockport, La.

Richard W. Sweet, formerly of Nucel Centralab, is now a Laboratory Technician for the Atlanta Paper Co., Atlanta, Ga.

Hayden Tanner, formerly of the Thomas & Norris Mfg. Co. Ltd., is now Research Chemist for Albert E. Reed & Co., London, England.

Peter P. Taranoff is now Technical Director of the St. Helens Pulp & Paper Co., St. Helens, Ore.

R. I. Thieme, formerly of the Coos Bay Div., is now Assistant Manager of the Scott Paper Co., Chester, Pa.

Roy F. Traver is now Chief Chemist of the Camp Mfg. Co., Franklin, Va.

Paul D. Van Derveer, formerly of the Johns Manville Corp., is now a Laboratory Technologist for the Latex Fiber Industries, Beaver Falls, N. Y.

Carl A. von Ende is now Manager of Manufacture of the Gilman Paper Co., Gilman, Vt.

Harold C. Wall is now Technical Superintendent of the Longview Fibre Co., Longview, Wash.

Allan T. Walsh, formerly with the General Electric Co., is now Technical Director of the Chemical Paper Mfg. Co., Holyoke, Mass.

Thurman C. Warren, Technical Superintendent of the International Paper Co., has been transferred from Ticonderoga, N. Y., to New York City.

J. Lloyd Weaver, formerly of the Fairbanks Fibre Box Co., is now Vice-President in Charge of Production of the Twin Cities Container Corp., Coloma, Mich.

Herbert B. Wenberg is now Assistant to the General Manager of the Nicolet Paper Co., W. De Pere, Wis.

Robert E. L. Wheless is now Bleach Plant Superintendent of the Camp Mfg. Co., Franklin, Va.

Baxter L. Willey is now Assistant Paper Mill Superintendent of the West Virginia Pulp & Paper Co., Luke, Md.

George E. Wilson, formerly of the Don Valley Paper Co., is now Manager of Operations for the Alliance Paper Mills Ltd., Merritton, Ont.

* * *

Donald F. McCall has succeeded *A. B. Moody*, Vice-President and General Manager, as the official corporate representative in TAPPI of the Everett Pulp & Paper Co., Everett, Wash.

F. T. Ratliff has succeeded *G. R. Kuhlman* as the official corporate representative of Personal Products Corp., Milltown, N. J., in the Technical Association.

F. S. Bingman has succeeded *J. A. Canwel* as the corporate representative of Federal Paper Board Co., Bogota, N. Y., in TAPPI.

Richard M. Elias has succeeded *Foster P. Doane, Jr.* as the official corporate representative of the Bergstrom Paper Co., Neenah, Wis., in TAPPI.

* * *

Robert E. Engley, Manager of Pulp and Paper Mill Sales, has succeeded *Frank Cole*, retired, as the official company representative of the Walworth Co., New York, N. Y., in TAPPI.

The Glidden Co. offices in Chicago, Ill., have been moved from W. Moffatt St. to 1825 Laramie St.

J. F. Gschwind has succeeded *Wm. V. Knoll* as the official company representative of the Ross Midwest Fulton Corp., Dayton, Ohio, in TAPPI.

Loren Gallup, Assistant Vice-President, has succeeded *W. O. Hisey* as the official company representative of the Sandy Hill Iron & Brass Works, Hudson Falls, N. Y., in TAPPI.

L. E. West has succeeded *L. D. Wilson* as the official company representative of Dowell, Inc., Tulsa, Okla., in TAPPI.

The name of the *Buffalo Electro-Chemical Co.* has been changed to the *Becco Chemical Div.*, Food Machinery & Chemical Corp., Buffalo, N. Y.

J. G. Wells, Jr., Sales Manager, has succeeded *Frank Brook* as the official company representative of the Lobdell United Div., United Engineering & Foundry Co., Wilmington, Del., in TAPPI.

Kenneth Arnold, Manager of the Paper Dept., has succeeded *Robert Strasser* as the official company representative in the Technical Association.

T. F. O'Brien has succeeded *F. P. Mackinney* as the official company representative of the Sandoz Chemical Works, Inc., New York, N. Y., in TAPPI.

Harold D. Stuck, Vice-President, has succeeded *A. C. Clarke* as the official company representative of John W. Bolton & Sons, Inc., Lawrence, Mass., in TAPPI.

E. J. Ward, Vice-President, has succeeded *Palmer J. Lathrop* (deceased) as the official company representative of the Cameron Machine Co. in TAPPI.

Industry Notes

Production

As the paper industry entered the fourth quarter of the year, its production record strongly indicated that, in terms of output, 1954 would in all probability become the second best year in its history. It appears probable that production for the year will be exceeded only by that of 1951. Unshipped orders, although continuing to be of a volume greater than the average for the first 9 months, diminished slightly to become 60,000 tons, equal to about 14 days' production.

Production of Paper and Board, First Nine Months 1954 and Relationship to Production During the First Nine Months of 1953, 1952, and 1951

	Production first nine months 1954	*Per cent change from first nine months*		
		1953	*1952*	*1951*
Group A—Printing and Similar Papers	2,663,750	−0.4	+ 5.3	+ 1.9
B—Fine Papers	971,852	+1.1	− 1.8	− 2.9
C—Coarse Papers	2,550,193	+1.2	+ 4.7	− 4.3
D—Tissue Papers	1,188,235	+5.9	+19.0	+ 5.7
E—Miscellaneous Papers	383,145	−7.8	− 1.1	− 5.6
F—Total Groups A–E	7,757,175	+0.9	+ 5.7	− 0.7
Newsprint	861,034	+8.7	+ 2.6	+ 4.1
Building Paper	1,006,923	...	+ 3.6	− 8.3
Total paper	9,625,132	+1.4	+ 5.2	− 1.1
Paperboard	8,945,580	−4.0	+13.3	− 3.0
Building Board	1,103,828	+4.0	+14.6	+12.8
Total board	10,049,408	−3.2	+13.4	− 1.5
Total paper and board	19,674,540	−1.0	+ 9.2	− 1.3

Wood pulp production in August of 1,572,000 tons was the second highest on record, bringing total production for 1954

through August to 11,948,000 tons. The increase of 276,000 tons over the comparable period for 1953 is a continuing reflection of the decreased imports and rising exports of wood pulp.

Production and shipments of newsprint in North America during October, 1954, amounted to 636,324 tons and to 649,242 tons respectively, compared with corresponding totals of 607,884 tons and 602,832 tons in the same month of 1953. North American production and shipments in October, 1954, exceeded the levels of any previous month. Output in the United States was 110,328 tons—the highest monthly total since May, 1930—and shipments were 107,407 tons while Canadian (including Newfoundland) production amounted to 525,996 tons—the peak monthly record to date—and shipments totaled 541,835 tons.

Wastepaper

In the 105 months from January, 1946, to October, 1954, in only 14 did the Eastern mills purchase an average weekly tonnage of wastepaper exceeding that of October, and 9 of those 14 months were during the Korean war boom. In only 21 months of those 105, did the average weekly consumption of paperstock by these mills, exceed that of October, 1954.

The total national consumption of wastepaper in 1954, it is estimated, was over 8 million tons, but did not reach the $8^1/_2$ million tons consumed in 1953.

Australia

The following information is from a survey prepared by the Australian Dept. of National Development, Industrial Division, as published in the October 21 issue of *The World's Paper Trade Review.*

Three major companies in Australia produce about 90% of the pulp and paper industry's current annual output of about 270,000 tons.

Main products and approximate capacity per annum are: newsprint (70,000 tons), other papers (80,000 tons), and paperboard (120,000 tons).

Australia's annual requirements of paper and paperboard is of the order of 500,000 tons. Of this amount, some 200,000 tons would be newsprint, 170,000 tons "other papers," and 130,000 tons paperboard.

Approximately 55% of total requirements is met by local mills, the remainder being imported. Employees in the industry number about 7000.

Pulp

Local pulp mills, using chiefly Australian eucalypt, now produce about three quarters of the industry's requirements, the balance—mostly long-fibered pulp—being imported. Expansion of pulp mills is in progress, but for some time to come Australia is likely to need these imported pulps.

Newsprint

Increased power supply in Tasmania has enabled the only Australian newsprint mill to step up its production substantially since October, 1953.

Output during the three months to February, 1954, at 14,700 tons, was about double the production in the corresponding period of last year (6,900 tons).

However, Australia continues to rely heavily on overseas supplies of newsprint: of total newsprint supplies available during the second half of 1953—approximately 110,800 tons—84,500 tons (valued at £5.3 million) were imported. The balance (26,300 tons) was produced locally.

Other Papers and Paperboards

Output of wrapping papers and boards has increased by one third since October, 1953, and is at peak levels. Prospects are sound for continued high production. Writings and printings output, however, has not risen from the lowe level reached in October—some 10% below March, 1953.

In this section of the industry, employment now stand at about 3% above the level of six months ago.

Sales of wrapping papers and boards have continued brisk during the last six months, the larger consumption reflectin greater general industrial activity.

Demand for these items is rated higher than in early 195 (previous peak) and is expected to continue to rise.

Demand for locally made writing and printing papers whic had been well sustained till about May, 1953, has continue at the lower level of last October. This diminution in deman appears to have been due largely to falls in prices of compara ble overseas materials.

Delay in recovery is attributed to unwillingness on the par of buyers to commit themselves prior to the decision on th amending tariff application which was made public i February, 1954. The new lines of local writings and printing are being well received.

The demand for coated papers has been increasing ove the last few months, but coated boards are still holding th low level of March, 1953. The market for the new locally made vegetable parchments continues stable.

Easing of important restrictions and the replacement o higher quality Australian papers by lower grade overseas materials have been viewed with some concern by the Australian companies. The increases in duty on certain papers and paperboards recently announced, will, however, aid local manufacturers to meet overseas competition in these lines.

Prices

Prices of local wrapping papers and boards, although reduced since October, 1953, by amounts averaging about 0.5%, are still a little below overseas prices.

Prices of imported writing and printing papers which for many years had been well above those of comparable local lines, have fallen substantially. Generally, prices of local and overseas writings and printings are now comparable.

Production of newsprint (writings and printings) and wrapping papers and boards is at peak levels; other papers some 10% lower than peak levels.

New Zealand

Much of the recent development in the paper industry in New Zealand is based on timber from man-made forests. A large area on the north island was selected after World War I as the site for a planting program that was continued through the 1930's and is now yielding mature timber. It is claimed that Douglas-fir grows twice as fast in this area as in North America, and that spruce grows six times as fast as in Canada.

Finland

The first paper machine of the United Paper Mills new mill on the Kaipola headland of Lake Paijanne in central Finland is now in operation. When the second machine is completed the mill will have an annual capacity of 120,000 tons of newsprint.

Israel

Cargal Co. of Bnei Brak, Israel, has established a corrugated container plant with the objective of introducing the most modern packaging and packing methods. The company was founded in 1953 under a group of Canadian and American businessmen headed by Samuel Dubinger of Toronto, Canada.

New England

The Oct. 20, 1954 issue of *Paper and Paper Products,* 95 Worth St., New York, N. Y., is devoted to a review of the

paper industry in New England, and features the city of Holyoke, Mass.

Texas

East Texas Pulp and Paper Co. is now in operation at Evedale, Tex. The $27.5 million mill is a joint venture of Time, Inc., and Houston Oil Co. of Texas. The 300-ton mill produces bleached kraft pulp and paper.

British Columbia

A $65 million newsprint and wood pulp mill is planned for Kitimat, British Columbia, by Aluminum Co. of Canada and Powell River Co.

Ohio

The name of George Friend is one which appears more frequently in the annals of Miami Valley's paper history, than almost any other individual's. George Friend at one time had a tremendous amount of influence, great wealth, and the reputation of "big time papermaker and financier."

The exact date of Friend's arrival in Ohio is not precisely known, although it seems certain that he moved here during the latter part of the 1860's. He had experience, possesssions, and a reputation by the time he appeared on the Miami Valley scene, having operated a sulphite mill in upper New York State.

The subsequent history of the man's initially successful efforts and later overextension and consequent failure, provide quite an insight into a particularly interesting aspect of this historical study; one of which we have touched only briefly in the past.

Stated simply, it's this: Many of our contemporary mills are related in their "ancestral trees." But, because this aspect of our history is amazingly complex, only some examples can be given because, as usual, space is at a premium.

The Sorg Paper Co. of Middletown and the Gardner Board and Carton Co. of the same city, for example, have a common ancestor, Hill & Sons. The firm, organized in 1853, developed two individual offsprings during the course of time. The first was the Globe Division which successively became the Barntz Paper Co., The Gardner Paper Co., The Tytus Gardner Co., The Tytus Mill, and finally The United Box Board Co. of Middletown. The Tytus Gardner Paper Co. of 1893 had two mills, both in Middletown, and from one of these, today's Gardner Board and Carton Co. developed indirectly.

The second division of the "ancestral" A. Hill & Sons firm was The Valley Mill Division built in 1866, and known later as Hill & Peck. This mill subsequently became the Middletown Paper Co., the Jacoby Paper Co., the Paul Sorg Paper Co., and finally the Sorg Division of today's Sorg Paper Co.

Here is another excellent example of family trees and common ancestors: The Logan Long Co. of Franklin, Gardner Board and Carton Co.'s Lockland Mill, and the Philip Carey Mfg. Co., also of Lockland, are historically related. The Gardner Lockland Mill had its beginning as the Haldeman Paper Co., established in 1864. It was first known as the Upper Lockland Mill to which the Lower, or Maplewood Mill, was added a little later. This Maplewood Mill was succeeded in 1907 by today's Philip Carey Mfg. Co. of Lockland. The Upper Haldeman Mill also changed hands in 1907, becoming the Richardson Paper Co., taken over in turn by Gardner of Middletown. This formed the Gardner-Richardson Co., the forerunner of today's Gardner Board and Carton Co. The "third cousin" in this family is the Logan-Long Co. of Franklin. This mill, another one of the really old firms, shared officers with the Haldeman Paper Co. of Lockland in 1900, and since it was known as the Richardson Paper Co. it can be assumed to have become connected closely (if only financially) with the Richardson Paper Co. of Lockland a few years later. This Franklin mill was later known as the Patent Vulcanite Roofing Co., the Vulcanite Roofing Co., and finally (in 1923) the Logan-Long Paper Co.

Back tracking once more to the Haldeman Paper Co. of Lockland will eventually get us back to George Friend with whom we started and whom we disregarded soon afterwards. There was another Haldeman Paper Co., this one in Rockdale, close to Hamilton. This mill started as George P. Tangeman and Co., organized in 1873. In 1888 it was operated by the Union Straw Board Co. and later became a part of that "Straw Empire," treated here previously: The American Straw Board Co. True to style, the mill was managed to idleness in short order but it was later revived as The Friend & Forgy Paper Co. . . . re-enter: George Friend. Friend, in turn, did not maintain this mill for any length of time. It reverted back to the Tangeman interests and shortly thereafter, in 1893, it became part of the Haldeman Paper Co., with J. C. Richardson, president. Still later it became the E. Bowen Co., known as the Star mill and it was finally closed in 1910.

If we were to follow the Tangeman branch of this "tree," we would be led back to Lockland where another mill was owned by these interests, or if we followed the Tangeman Rockdale mill story we would be led to the Upper Sandusky Straw Board Co., and from there back to the American Straw Board Co.

—by Ernest F. Barker, in *Ohio Tappi*, Oct. 7, 1954.

Wisconsin

Eight Wisconsin sulphite mills used soil filtration techniques during 1954 to reduce stream pollution. The total quantity of spent liquor disposed of amounted to more than 295,000,000 gallons.

The Paper Industry

The paper industry is the fifth largest in the United States, being exceeded in size only by automobiles, meat packing, steel, and oil. Estimated sales for 1953 were $8,700,000,000 and the annual payroll for the 225,000 workers that are employed was about $900,000,000. This does not include salaried employees or woods workers. The United States consumes more than 60% of the world's total paper output. Per capita consumption in 1953 was 155 lb. of paperboard, 75 lb. of newsprint, 45 lb. of book and other printing grades, 42 lb. of coarse grades, and 18 lb. of building board.

Protected Seeds

A new German dye chemical, tetramethylene disulphotetramine, is being used to protect seeds against rodents without disturbing germination. Experiments in Oregon showed that an estimated 11,800 Douglas-fir seedlings per acre grew from protected seed, compared with 1680 from untreated seed. In South Dakota protected seed achieved 87% stocking, unprotected seed, 4%. The Washington State Forestry Service estimated stocking at 10,164 Douglas-fir seedlings per acre for treated seed, 872 for untreated.

The new method may permit inexpensive reseeding of areas laid waste by fire, insects, and lumbering, where formerly reclamation was a dubious process because deer mice took most of the seed sown.

—from *Chemical Week*, Oct. 16, 1954.

Forest Publications

The Northeastern Forest Experiment Station, Forest Service, U. S. Dept. of Agriculture, Upper Darby, Pa., has published a bulletin on Logging Beech and Specifications for Beech Products. Station Paper No. 71 is titled "What Is This Thing Called Growing?," Station Paper No. 73 is on "Cutting Mountain Hardwood Stands," and Station Paper No. 72 is a report on "Forest Insect Conditions in the Northeast—1953."

New Plants and Processes

The following new plants and facilities were announced, planned, under construction or completed during the last half of 1953 or the first half of 1954:

Firm	*Location*	*Products*	*Dollars*	*Status and remarks*
Bowaters Southern	Calhoun, Tenn.	Newsprint	51,000,000	Capacity, 50,000 tons kraft pulp and 125,000 tons newsprint per year; under way
Crossett	Crossett, Ark.	Paper	20,000,000	Plans announced late '53; to produce 150 tons per day bleached container board
East Texas Pulp & Paper	Silsbee, Tex.	Paper, pulp	.....	Construction scheduled for completion late '54; 90,000 tons bleached sulphate pulp and paper board per year
Great Northern Paper	Millinocket, Me.	Newsprint	.....	Expansion under way; to make newsprint from hardwood
Hoberg Paper Mills	Green Bay, Wis.	Torula yeast	2,500,000	To use sulphite waste from pulp mill; project under way
International Paper	Camden, Ark.	Paper	2,000,000	Expansion under way; current capacity, 500 tons per day
Ketchikan Pulp & Paper	Ward Cove, Alaska	Pulp	46,000,000	Using magnesia-base pulping; in operation June, '54; 130,000 tons per year dissolving grade pulp
Newport Industries	Bay Minette, Ala.	Tall oil products	2,700,000	New unit on stream; capacity now 24,000 tons per year; processing black liquor skimmings and crude tall oil
St. Helens Pulp & Paper	St. Helens, Ore.	Pulp, paper	15,000,000	Expansion planned; will process 35,000 tons per year bleached kraft pulp
St. Regis Paper	Pensacola, Fla.	Kraft paper	4,500,000	Under way
Scott Paper	Everett, Wash.	Pulp	.....	Expanding facilities by 120 tons pulp per day
Southland Paper Mills	Lufkin, Tex.	Newsprint	.....	Will expand by 70,000 tons per year to 200,000 tons per year
Valentine Pulp & Paper	Lockport, La.	Pulp, newsprint	4,500,000	In operation late '53; 50 tons pulp per day; new process uses sugarcane bagasse as raw material

The following new developments have been announced, commercialized, or have become particularly newsworthy during 1953 or the first half of 1954:

Product	*Process*	*User and location*	*Features*	*Status and remarks*
Battery separators	Wood fiberization	Evans Products Co., Coos Bay, Ore.	Wood is fiberized and reformed into finished separators	In production
Black liquor recovery	Combustion	.....	Rearrangement of heating surfaces in superheater cuts slag formation; spray gun delivers superheated feed which gives partial flash drying	Offered by Combustion Engineering, Inc.
Cellulose	From banana stalks	Cia de Cellulise Banex, Brazil	.....	Process developed in Britain; known as Polpex
Crepe paper	.....	General Electric Co., Pittsfield, Mass.	Made of kraft and manila fibers; has triple the strength of previous industrial crepe paper	Used for cable wrapping
Kraft pulp	Odor control	Nekoosa-Edwards Paper Co., Nekoosa, Wis.	Chemical agent added to digester masks odors throughout pulping and recovery systems	Developed by Du Pont, used on trial at Nekoosa
Newsprint	Semichemical pulping	Kinsey Chemical Co.	Allows use of 40% poplar wood in newsprint compared to 20% previously used successfully	Process announced late 1953
Newsprint	Alkaline extraction of bagasse	Valentine Pulp & Paper Co., Lockport, La.	First commercial mill for newsprint from bagasse will use rapid processing cycle including prehydrolysis followed by alkaline extraction and light but conventional refining	Spending $2.6 million for 50-ton/day mill; Rayon Corp. of the Philippines plans to make dissolving pulp from bagasse
Newsprint	Chemigroundwood	Great Northern Paper Co., E. Millinocket, Me.	First use of hardwood for newsprint in North America; process involves pretreatment of hardwood in pressure vessels, followed by grinding; product is mixed with softwood pulp	Experimental work completed; Great Northern is expanding output and including facilities for new process
Newsprint	Papermaking	Beloit Iron Works, Beloit, Wis.	Suction pickup and transfer system moves fragile web from fourdrinier wire to press suction; permits higher running speed	.....

Product	Process	User and location	Features	Status and remarks
Paper	Press roll load control	Gibralter Corrugated Paper Co., North Bergen, N. J.	Strain gage load meter measures roll loading within 0.25%	Installed and operating
Paper	Weight control	Strathmore Paper Co., West Springfield, Mass.	Absorption beta gage assures uniformity; holds sheet weight to less than 3% variation	Installed and operating
Pulp, bleached	Chlorine dioxide	Riegel Carolina Corp., Acme, N. C.	Plant manufactures own chlorine dioxide from sulphuric acid, sodium chlorate, methanol vapor, and air; water solution at 160° F. is used as last bleaching stage for pulp after hypochlorite bleaching	Plant built and process developed by Solvay Process Div., Allied Chemical & Dye Corp.
Pulpwood	Chemical debarking	Various	Live trees are debarked by use of sodium arsenite	17 firms have purchased process for public use
Sulphite pulp	Continuous	American Box Board Co., Filer City, Mich.	A completely continuous process for making pulp from hardwoods; includes new, continuous digester, together with refining and screw press washing	Designed by American Box Board and Sumner S. Solitt Co.; a 13-ton/hr. plant is in operation
Sulphite pulp	Magnesia base	Weyerhaueser Timber Co., Longview, Wash.	Process substitutes MgO for lime; big advantage is nonpollution of streams since all waste liquors are burned for power generation	Now operating commercially on 300-ton/day scale; process is being used also by Ketchikan Pulp Co. in new Alaska mill
Sulphite pulp	Soda-base pulping	Nekoosa-Edwards Paper Co., Port Edwards, Wis.	Process substitutes caustic soda for limestone in making sulphite cooking liquor; this is expected to make cooking liquor recoverable and so cure pollution problem	Developed by Western Precipitation Corp.; about 500 tons of pulp have been made by this process but critical evaluation of recovery process will be needed before company can decide to go ahead
Wood panelboard	Continuous	Bartrev, Ltd., Colchester, England	Resin-treated wood particles are fed in continuous carpet on stainless steel belt, bonded by heat and pressure; finally emerge as continuous length of board	Available in U. S. through Aries Fiberboard Corp., New York
Wood pulp	Va-Purge	Various	Preliminary steaming and purging step gives faster, more complete liquor penetration of wood chips, shortens cooking time, increases yield and uniformity	Undergoing trials in a number of mills

—from *Chemical Engineering*, Inventory Issue, Mid-September, 1954.

Paper Conditioning

Paper that is to be run offset is today manufactured so that its moisture content will be in balance with the normal humidity prevailing in today's modern conditioned pressrooms. However it is recognized that normal or abnormal humidity fluctuations make it necessary to bring the paper into balance with the existing pressroom conditions before putting it to press. For the latter purpose, the following general temperature conditioning chart for paper, prepared by the Lithographic Technical Foundation is proving of considerable value:

Cubic Volume of Paper on Skids or in Cases

Temp., deg.[a]	*6 cu. ft.*	*12 cu. ft.*	*24 cu. ft.*	*48 cu. ft.*	*96 cu. ft.*
10	5 hr.[b]	8 hr.	11 hr.	14 hr.	15 hr.
15	9 hr.	14 hr.	16 hr.	19 hr.	20 hr.
20	12 hr.	18 hr.	23 hr.	26 hr.	27 hr.
25	15 hr.	22 hr.	28 hr.	32 hr.	34 hr.
30	18 hr.	27 hr.	35 hr.	38 hr.	41 hr.
40	25 hr.	38 hr.	48 hr.	54 hr.	57 hr.
50	35 hr.	51 hr.	67 hr.	75 hr.	79 hr.
60	54 hr.	78 hr.	100 hr.	109 hr.	115 hr.

[a] Temperature difference between paper on arrival (outdoor temperature may be used for easy calculation) and temperature of pressroom (room in which paper is to be opened).

[b] Time paper should stand unopened, in order to come into balance with room temperature.

Note: Determine cubic volume of paper on skid or in cases by multiplying length by width by height (in inches) and dividing by 1728.

—from *The Fraser Voyageur*, August, 1954.

Rubber Hose

A user of rubber hose can get longer life and more satisfactory performance by applying this check list to each hose in his plant, construction job, machine, mine, or quarry and to each hose specified for purchase in the future.

1. *Material Carried.* If the hose carries any kind of petroleum product, the tube should be compounded to resist attack by oil, grease, or gasoline, for example. There are several standard hose types available designed for this type of service. Paint and insecticide spray hose must be built to resist the various solvents incorporated in the new paints and insecticides. Many kinds of dilute acids can be carried by rubber hose but the user should make sure that the hose he is using is designed for the acid. Solids carried either dry or in a slurry require that the tube of the hose be composed of pure gum rubber type to resist abrasion. If the solution contains acid, petroleum products, or other solvents, various additives must be compounded into tube rubber to resist them.

2. *Hose Size.* Is the inside diameter adequate to carry the volume of material required? Too small a hose means excessive pressures will be developed or that less than the required amount of material will be carried. Too large a hose means higher cost than necessary, poor, and irregular flow.

3. *Pressure.* Is the hose designed to take the pressures imposed? Are you using higher pressures than you need to, which results in excessive hose cost? Is the pressure constant or is it pulsating? Pulsating pressures should be

avoided. Is the pressure positive or negative—under vacuum or suction? Suction hose requires a spiral or ring type reinforcement in the carcass to prevent hose collapse under suction.

4. *High and low temperatures* must be watched. High temperature applications require special rubber compounds and asbestos or other heat resisting material in the carcass. Running both hot and cold material through a hose should be avoided. Constant heating and cooling may cause cracks to develop in the rubber tube and cover permitting direct attack on the carcass. As far as possible a hot steam hose should be drained after use to prevent pocketing of condensate which becomes absorbed by the hot tube stock leading to eventual blistering if continually repeated.

5. If *solids* are carried in the hose, what are their relative size and abrasiveness? Abrasive material in an aqueous solution requires a pure gum rubber tube. If the solids are carried in a corrosive liquid, the tube must be compounded to resist attack by this liquid and a compromise hose results.

6. Know and observe *bending radius limits* of your hose. The most common fault is suspending hose off the floor or ground by metal projections with too little bearing area such as nails. Avoid the use of nails because of their small diameter. In addition to unnecessarily bending the hose at these points, the cross section of the hose is reduced. Resistance to flow is increased; unnecessary turbulence is set up. Use saddle type supports with adequate bearing contact with the hose.

Put supports close enough together so that hose weight is evenly distributed, so that large hanging loops do not affect flow of material, so that hose is not strained by supporting too much of its own weight.

The bending radius of most industrial hose is, approximately 1 ft. for every inch of inside diameter of the hose.

When the hose is regularly flexed as in reciprocal hydraulic applications, bending radius limitations should be watched most carefully.

7. *Length.* Obviously a hose system should be designed to avoid stretching. This weakens the hose and puts unnecessary strain on the coupling. Too much length runs up the hose cost and permits snagging and kinking.

8. *Twisting.* Avoid twisting or torsional strains, especially in short hose lengths. Twisting will tend to separate the reinforcement from the tube and cover. It may even seriously disarrange the reinforcement. In a wrapped hose in which the reinforcement is cut diagonally to the warp of the fabric, twisting may weaken the structure.

9. *Cycle of Operation.* Many hose do the same job at the same pressures and temperatures 24 hr. a day without valves being shut off and on. Other hose may be subjected to an extremely vigorous cycle with many sudden interruptions in flow, long periods of idleness, wide temperature variations and even drastic changes in environment. Consider, for example, deep sea operations. For several hours a day, the hose is immersed in cold salt water. Then it is brought up on deck and stored in hot, strong sunlight. This represents a challenge to the hose designer but it also requires consideration from the user who can obtain longer hose life with standard hose by reducing the severity of some parts of the operation.

In many types of hose service, the position of the hose is changed frequently. More often than not, it is dragged from place to place. An abrasive resistant cover is needed. In addition, if the moves are very frequent, a quick-disconnect type of coupling will save time.

When hose is not to be used for a long time, it should be drained, wiped clean of oil or grease, and stored in loose coils, preferably flat on the floor, inside, out of the sun.

10. *Couplings.* Are the correct types of couplings being used? Are they correctly installed? Are they properly maintained? Tightened periodically? Checked for leaks? If service requires frequent disconnecting, are the couplings designed for easy, fast disconnecting?

11. *Protection Against Accidental Damage.* In hazardous areas, are hose protected against damage from falling rocks from heavy vehicles at hose crossings? Is the hose kept out of strong sunlight as far as possible? Are you protected against work stoppages by accidental hose failured by an adequate stock of spare hose and couplings?

12. *Working Conditions.* In many cases the ambient temperature and pressure must be considered. The temperature of the room in which the hose works must be added to the temperature of the material being carried.

—by J. A. Muller, *Thermoid Co., Trenton, N. J.*

Instrumentation

The first of a series of seven volumes on Government-owned inventions scheduled for publication this year under the joint sponsorship of the Dept. of Commerce and the Small Business Administration has just been published. This book lists 775 Government-owned inventions in the field of instrumentation, with a brief description of each invention. The book, titled "Instrumentation" (Order No. 11464) may be purchased for $2.00 a copy from the Office of Technical Services, Dept. of Commerce, Washington 25, D. C.

New Core Board

It isn't often that wood-using industries and timber conservationists get enthusiastic about the same thing. Yet, that is just what has happened to a new type of "core board" that is made out of anything that comes from a tree.

Not only does the new board make use of every scrap of wood, but it promises to shave a few dollars off the price tags on such things as dinette tables and office furniture. Prefabricated houses without studding can be built with the new core board; lighter truck bodies and house trailers can be made with it.

In May, 1953, Ted Connelly, president of the Dean Co., Chicago, while in Germany saw core board extruded continuously from wood waste. "Cores" are the solid backing to which the furniture industry bonds wood veneers, such as mahogany, walnut, or maple, making possible beautifully decorated furniture at a price the average family can afford. It was only natural that Connelly became interested when he saw the process that would take wood scrap, bark, trimmings, or whatever at one end and turn out core board continuously at the other end.

Returning to the United States, he reported his discovery to Arnold Habig, president of the Jasper Corp. at Jasper, Ind. The upshot was that Habig and Connelly made a flying return to Germany in August, 1953: The junket took ten days. Habig returned with a core board plant on order for early shipment, Connelly with sales and distribution rights to the O. K. Kreibaum process for the United States, Mexico, West Indies, Japan, and the Philippine Islands.

In just five months, Habig was ready with the Jasper-American Corp., an almost inexhaustible supply of discarded wood, and two machines operating in a new plant at Henderson, Ky.

There, in a galvanized iron shed, a wood chipper chops up bark, edgings, scrap, trim—anything the operator feeds into its hopper. Behind the shed, the wood scrap from adjacent Scott Lumber Co. covers five acres to a depth of 6 ft.

A second chipper reduces the chips coming from the first machine to half-inch size, after which they are dried, impregnated with a Monsanto wood-bonding resin, and fed into the Kreibaum core-making machine.

It compresses the chips and at the same time cures the bonding resins with heat. Out the other end, it delivers a continuous sheet of core stock. A saw cuts off panels in standard lengths.

While, in thinner thicknesses, the Kreibaum board comes in solid form, usually core stock $^3/_4$ in. or more in thickness comes from the machine with a series of tubular holes running the length of the panel. This feature reduces weight; for building purposes it provides a dead air space for insulation.

Several trials, using Monsanto's phenolic resins, demonstrated that the "tubular chipboard," as it is sometimes called, could be veneered with hardwoods, softwoods, aluminum sheet, and melamine overlays. Nails and screws held well in the veneered core board. For all practical purposes, Habig's core board had complete dimensional stability.

Once Habig was satisfied what his core board would do, he announced himself ready to supply all comers. At first he considered offering just core stock, custom-made to thickness and size. But then, with ample space for veneering—Jasper-American went ahead to supply veneer-faced and edge-banded panels in any size the furniture, cabinet, or prefab housing industry might want.

The first customer for core board was a manufacturer of fine furniture and cabinets. He was closely followed by a producer of radio and TV cabinets.

Then a trailer manufacturer and a prefab home builder came to talk of laminating aluminum sheet to cores for house trailers. They proposed to laminate core board with a knotty pine veneer to the interior surface; aluminum to the exterior. Then, preformed panels could be used in trailers or housing, greatly reducing the number of studs. Jasper-American found it could readily rout the edges of wall panels made of the material to fit window frames and door sash.

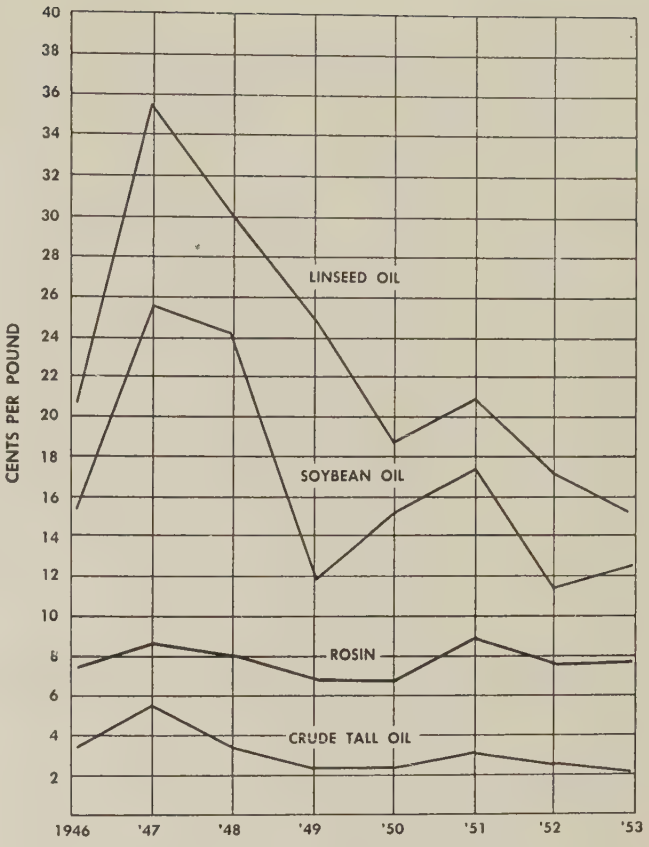
Tall Oil

Tall oil, the low-cost, stable source of inedible fatty acids and of rosin derived as by-products of the rapidly growing southern kraft paper industry, is widely used by paint and varnish producers and the surface coating, soap, detergent, paper, and chemical industries. Among other industries benefiting from the technological advances and improvements achieved in the last 10 years by both producers and users of tall oil products are linoleum and floor coverings, metallic driers, disinfectants, flotation reagents, core oils, and asphalt additives.

Tall oil production has increased rapidly from 50,000 tons in 1943 to 175,000 tons in 1953. Processing methods have been developed which allow not only the production of products of higher purity, but also the substantially complete separation of tall oil into rosin and fatty acids. Fatty acids substantially free from rosin acids and rosin substantially free from fatty acids are now being produced. With continued growth of the industry, and future advances in tall oil technology, products of even greater refinement and wider utility may be expected in the not too distant future.

A major reason for the growth of tall oil production is the economical and stable source of "black liquor soap"—by-product from the manufacture of kraft paper by the sulphate paper process—from which tall oil is made. A dependable supply of "black liquor soap" has kept the price of crude tall oil fairly steady during the last 8 years, This is in contrast to the fluctuating prices for other inedible oils and for rosins during the same period of time. The price of tall oil, as compared to the much higher prices of fatty acids and rosin, has inspired chemists and engineers to upgrade tall oil products and to attempt its separation into rosin and fatty acids. The hundreds of patents issued and numerous papers published since the beginning of the century, when tall oil was first discovered in Sweden, give testimony to the imagination and resourcefulness which has been applied to these problems.

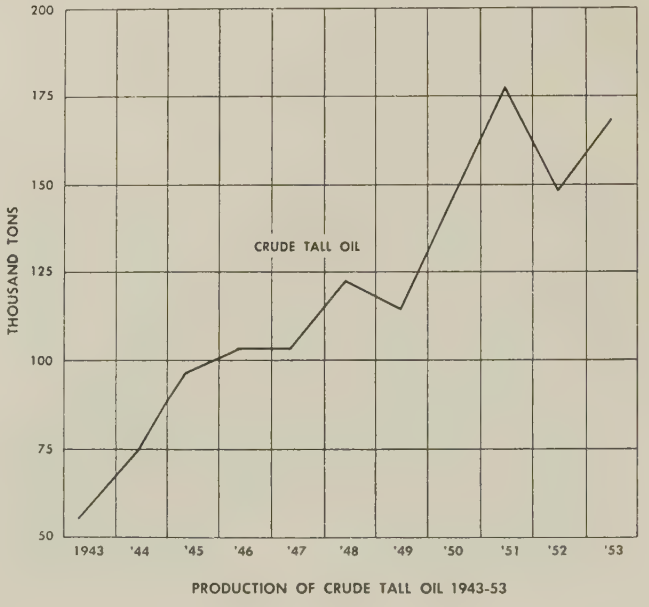
The major processes of tall oil manufacture now fall into three principal groups: acid refining distillation, and fractional distillation. The problem of complete separation of tall oil into fatty acids and into hard vitreous rosin comparable to gum and wood rosin was finally solved by a more elaborate



PRICES OF CRUDE TALL OIL, LINSEED OIL, AND SOYBEAN OIL

fractional distillation process. Developed in the laboratories of the American Cyanamid Co., this process employed the newest fractional distillation techniques and equipment design, and achieves the separation of tall oil into fatty acids with a rosin content as low as 1% fatty acids. This process is now being carried out on a large scale at the Panama City, Fla., plant of the Arizona Chemical Co., a company owned jointly by American Cyanamid Co. and International Paper Co.

Complete separation has produced fatty acids which, due to their low rosin and unsaponifiable content, have moved into the class of semidrying oils and fatty acids. The rosin obtained by the complete fractionating process, has been ad-



PRODUCTION OF CRUDE TALL OIL 1943-53

mitted under the Naval Stores Act as tall oil rosin and is the only rosin derived from tall oil defined under this act. Obtained in very pale color grades, tall oil rosin is characterized by a low unsaponifiable content, high softening point, low fatty acid content, and freedom from impurities.

—by Richard Herrlinger, *American Cyanamid Co.*

Union Bag

Union Bag & Paper Corp., Savannah, Ga., is undertaking a renovation and replacement program which will involve the expenditure of several million dollars before it is completed in 1958. Major items in the program include a 500-ton recovery boiler and a 20,000-kw. turbogenerator.

St. Marys

The first and only modern multistage bleach plant of its kind in the United States, using chlorine dioxide, is now in operation in St. Marys Kraft Corp. plant at St. Marys, Ga., subsidiary of Gilman Paper Co. With this addition to to its vast pulp, papermaking and converting equipment, Gilman Paper Co., through its subsidiaries, which include Kraft Bag Corp., achieves complete integration at both mills, St. Marys, Ga., and Gilman, Vt. Both mills can now produce all shades of white and all shades of colors.

One of the many unusual engineering features of the new bleach plant is its multiple stages with towers so designed that different bleaching agents may be used at any one time, or any combination of them, to produce all degrees of brightness from semibleached to highest possible. Heretofore, bleach plants were restricted to one single system or sequence, whereas Gilman's new flexible system makes it possible to use a variety of processes. Another feature worthy of note is that the construction employed the very latest equipment, such as stainless steel, plastic membranes, ceramic linings, and glass lined materials, ensuring the production of the cleanest, highest grade of uncontaminated kraft pulp.

Much of the production of the new bleached kraft paper will go into Gilman's multiwall bags and other converting departments; but some will be made available to other manufacturers of bleached kraft paper products.

Crown Zellerbach

Crown Zellerbach's plans for a new kraft paper mill at Antioch, Calif., and a new kraft pulp mill at Duncan Bay, British Columbia, are in final engineering stages, with both mills scheduled to begin producing in mid-summer, 1956.

The proposed new kraft paper mill at Antioch, Calif., will be located on a 42-acre industrial site along the San Joaquin River. Its basic installation will be a 252-in. wide paper machine. The new machine, to be built by the Beloit Iron Works at Beloit, Wis., will have a daily capacity of some 400 tons of unbleached kraft papers for wrapping papers, grocery bags, and multiwall shipping sacks.

Unbleached kraft pulp for the Antioch mill will be supplied primarily by the projected Duncan Bay pulp mill. The new pulp mill, which will have facilities for producing about 400 tons of pulp daily, will be constructed alongside the newsprint mill at Elk Falls which was built in 1952. A chipper, barker, and other facilities will be added to the present wood mill to meet the new mill's wood requirements. Geared to British Columbia forest conservation plans, the wood used will come from salvage logging on lands formerly harvested for lumber operations, and from wood chips secured from plywood and sawmill waste of Canadian Western Lumber Co. and others.

Great Northern

The first new newsprint machine of Great Northern Paper Co.'s current expansion program is now in operation at East Millinocket, Me. This is the first phase of a $45 million modernization program.

International

G. H. Rand, International Paper Co.

George H. Rand has been appointed divisional manager for the northern mills of International Paper Co., replacing the late A. D. Maxim, who died in Glens Falls recently.

J. E. McCaffrey, assistant general manager in charge of woodlands operations for I. P.'s Southern Kraft division, has been elected vice-president of the company.

Rayonier

Rayonier, Inc. is producing "Rayflo," a reddish-brown powder, from western hemlock bark for use as a dispersant for oil well drilling muds. This is said to be the first of a series of "silvichemicals" to be produced by Rayonier. It is described as a complex polymeric polyphenol.

Ralph V. Zepp has been appointed resident engineer of the Rayonier Jesup, Ga., division.

K-C

When Kimberly-Clark started to make paper 82 years ago, its daily output was 2 tons of rag newsprint. Within 5 years, it was evident that rags could not furnish the pulp needed for continued expansion. To overcome this, the company established, in 1878, a mill to make manilla wrapping paper from jute butts and groundwood pulp. Two years later, a sulphite mill was built which also used wood for its raw material.

From then on, the company relied on wood for pulpmaking. The continued expansion of plant capacity created a greater demand for wood, which is estimated at a rate of 100,000 cords a year during the period 1900 to 1910. This led the company to organize, in 1909, the William Bonifas Lumber Co. This venture put Kimberly-Clark into the forest products business, both wholesaling and retailing, where it has remained ever since. Bonifas started to buy timberland in northern Michigan, and in northern Wisconsin. In 1916, Kimberly-Clark bought a controlling interest in North Star Timber Co. which began to purchase timberlands in Minnesota.

In 1928, after a period of reorganization and enlargement, the Spruce Falls Power and Paper Co. hired Robert W. Lyons as the first forester in the Kimberly-Clark organization. His arrival at Kapuskasing to work for Spruce Falls was immediately noticeable. He undertook to eliminate the system of contract logging and started producing pulpwood with company operated camps. He insisted that foresters be put in charge of these operations and be held responsible for their quota. He started the organization on its own accounting system to insure adequate cost control of those operations.

As soon as pulpwood production was reorganized, a forest management program was started. Field observations were made and recorded on thousands of acres of all age classes. Permanent sample plots were established to furnish a record of tree growth. Cutting experiments were laid out to find out how reproduction of black spruce could be improved. Here was an action program in forest research that has been a constant part of this company's woodlands development.

It had to be proved to the management of Spruce Falls and Kimberly-Clark that foresters could produce wood better than the regular producers. The foresters proved themselves to be better operators, by far, than the old timers.

Wood costs to the mill came down immediately. By 1936 eight years later, they were responsible for all of the wood procurement for Spruce Falls. In addition, foresters were making progress in research on the silviculture of black spruce. By this time, too, Kimberly-Clark's total consumption of wood was close to 375,000 cords a year.

The management of the company wanted to adopt a similar forestry program in the Lake States and asked Mr. Lyons to start it. So, in 1936, he became vice-president and general manager of the William Bonifas Lumber Co. with headquarters in northern Michigan. He became general manager of the North Star Timber Co. in Minnesota at the same time. Foresters were employed and plans were made and started for building up the forestry program. Experimental cuttings were made. Sample plots were laid out for permanent records. Growth studies were initiated and management plans developed.

During the disruption of World War II, the department was geared to all-out production of timber to keep the mills running. Meanwhile, in 1940, Mr. Lyons had moved his headquarters from northern Michigan to Neenah, Wis. to become, in 1942, general manager of the Woodlands Department. In 1945 he became assistant vice-president; in 1947 a director and in 1951 a vice-president. This was recognition of the importance of this department's activities. Foresters began to be a part of the staff at headquarters. The mills of Kimberly-Clark and Spruce Falls were consuming over a half million cords of pulpwood a year.

Postwar development brought additional expansion. Another new mill was built in Canada. Foresters, already in charge of an exporting limit, were ready to expand their operations for the new mill capacity. Then came additional expansion to Alabama. The Coosa River Newsprint Co. was organized to make newsprint from southern pine trees. Foresters were called upon to report if there was enough timber to supply the mill. They were put in charge of buying forest land long before the mill started its first run. They were responsible for getting wood to the mill and for keeping it going since then.

The older established parts of the woodlands department have been busy with their postwar development also. Spruce Falls' management plan called for a company operated nursery to help reforest the uplands types with adequate spruce trees. This was started in 1947 and is now turning out 2-2 spruce for both of the Canadian companies. North Star Timber Co. leased the Knife River Nursery in Minnesota. It is producing 2-2 spruce for the use of North Star and Bonifas in the Lake States. The first pine seedlings were lifted in the fall of 1953 from a nursery that the Coosa River Newsprint Co. established in Alabama. A new nursery is being developed this year by Bonifas at Lake Mary near Iron Mountain, Mich.

While forestry research is an important element of woodlands activities, it isn't all by any means. How can the damage to forests caused by insects and diseases be reduced? How can the damage to wood in storage be controlled? These questions called for technical answers so the department established a pest control laboratory in 1952 with an entomologist and a pathologist to run it. The results will be available to all landowners and should help them produce a higher quality of pulpwood for use in the corporation's pulp mills.

One hundred of the one hundred twenty foresters in the department are in administrative work and are responsible for delivering to the mills over 1,100,000 cords of wood a year. The other 20 are in the forestry division under the general direction of the chief forester.

The organization of the department is simple and direct. The vice-president has delegated the supervision of the work to Gordon G. Cosens, general manager. He, in turn, has G. W. Phipps as assistant general manager in Canada and T. R. Powell, as local manager in the Lake States. These men are responsible for logging operations and wood procurement. The chief forester, J. B. Millar, who is responsible for the development of the forestry program, reports directly to the general manager also. Each of the subsidiary and affiliated companies has its own woodlands organization with a forester as manager. Each of these woodlands organizations has its own forestry staff. In addition to working on forest management problems on company owned or leased land, these men give management help and advice to other landowners.

The future of forestry in this corporation promises to be just as interesting as past activities have been. There will continue to be additions made to the acreage of forest land now owned. There will be more intensive application of the silvicultural requirements for management of these forests. There will be a balance arrived at between the harvest of tree crops and the productive capacity of company owned forest land. This capacity will be built up, too, by "sweetening up" with planting, the areas that are partially stocked.

—by William J. Brown, *Kimberly-Clark Corp.*

H. & D.

In a booklet titled "How to Pack It," Hinde and Dauch Co., Sandusky, Ohio, illustrates its basic corrugated box designs and describes the special features and uses of each.

U. S. Plywood

United States Plywood Corp., New York, N. Y., has formed a flexible materials division with a new plant in Louisville, Ky., to manufacture products for wall coverings, luggage, automotive and upholstery markets.

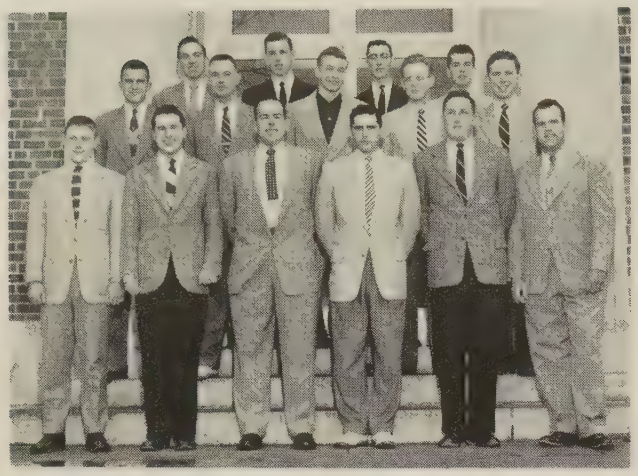
Lowell Tech

In memorial tribute to the late Geoffrey Broughton, first head of the paper engineering department at Lowell Technological Institute, scholarships contributed by 12 paper companies collectively have been named the Geoffrey Broughton Memorial scholarships. Mr. Broughton was chairman of the department of chemical engineering at the University of Rochester at the time of his death last September.

Paper awards for last semester were awarded to Fred Iannazzi, '55, of Lawrence, Mass.; Pier Jacques, '56, of Lowell, Mass.; and Edward N. Novick, '57, of Jersey City, N. J.

Companies contributing to the paper scholarship fund include the following: American Writing Paper Corp., Carter, Rice, and Co., Champion-International Co., Crocker, Burbank and Co., Chemical Paper Manufacturing Co., Fitchburg Paper Co., Robert Gair Co., McLaurin-Jones Co., Nashua Corp., Strathmore Paper Co., Tileston and Hollingsworth Co., Byron Weston Co.

Broughton scholars at Lowell Tech.



Junior and senior engineering students at the University of Maine receiving tuition scholarships from the University of Maine Pulp and Paper Foundation. Front row (left to right): A. W. Wheeler (Chemical), D. R. Alexander (Mechanical), W. L. MacDougall (Mechanical), J. G. Bergomi, Jr. (Chemical), F. J. Roberts (Mechanical), E. A. Ludwig (Chemical). Second row: E. E. Mushroe (Mechanical), B. W. Ragon (Mechanical), B. M. Conant (Mechanical), P. A. Jones (Chemical), R. B. Arnold (Mechanical). Third row: G. K. Hutchinson (Mechanical), R. H. Cross (Mechanical), D. L. Boutin (Mechanical), W. B. Moody (Chemical). Not pictured: E. J. Harriman (Chemical)

U OF MAINE

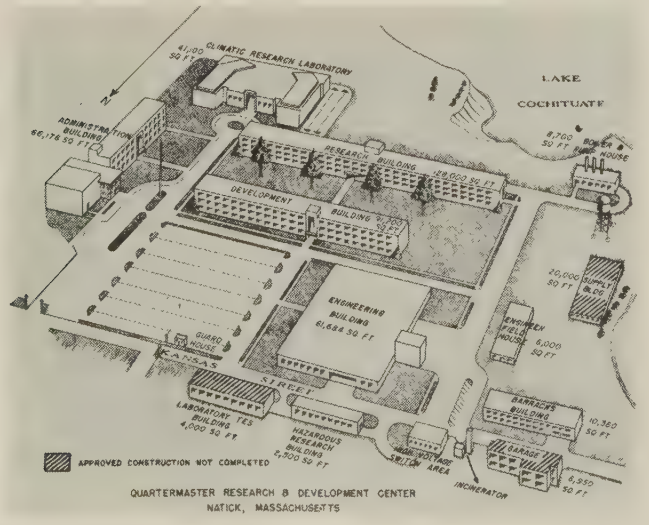
Over $22,000 in scholarships and grants has been awarded to 29 students in the pulp and paper program at the University of Maine, Orono, Me., for 1954–55.

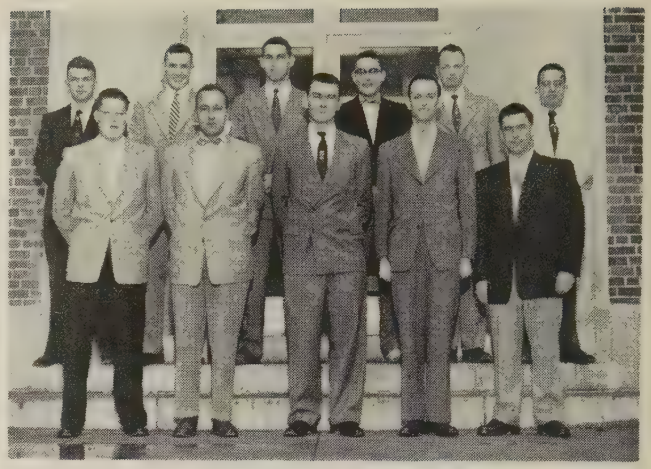
Lyle C. Jenness, head of the chemical engineering dept., was appointed chairman of the TAPPI Chemical Engineering Committee recently. Richard E. Durst and Andrew J. Chase, members of the Maine chemical engineering staff, were also appointed to TAPPI committees.

L. C. Jenness, University of Maine; Chairman, Chemical Engineering Committee

QUARTERMASTER R & D

The Army Quartermaster Corps is operating a new Research and Development Center at Natick, Mass., which houses the headquarters of the Quartermaster Research and





Fifth year University of Maine engineering students in the Operational Management Paper Course receiving $1200 grants from the University of Maine Pulp and Paper Foundation. Front row (left to right): M. L. Noyes (Chemical), Peter Economos (Chemical), P. I. Coughlin (Chemical), M. J. Jalbert (Mechanical), Donald Mavor (Civil). Back row: R. J. Kneeland (Chemical), R. A. Boss (Chemical), L. E. Clark (Mechanical), J. C. Barrows (Chemical), L. E. Robinson (Chemical), H. K. Ainsworth (Mechanical). Not pictured: N. G. Clarke (Chemical), G. E. Smith (Civil)

Development Command and includes most of the Corps' research and development laboratories. The center brings together operations previously conducted at Washington, D. C., Philadelphia, Pa., Jeffersonville, Ind., Lawrence, Mass., and Cameron, Va. Research in foods and containers is still carried on at the Quartermaster Food & Container Institute in Chicago, Ill.

SYRACUSE

The American Pulpwood Association has established a research fellowship at the State University of New York College of Forestry, Syracuse, N. Y., for the development of a directory of research in growing and harvesting pulpwood.

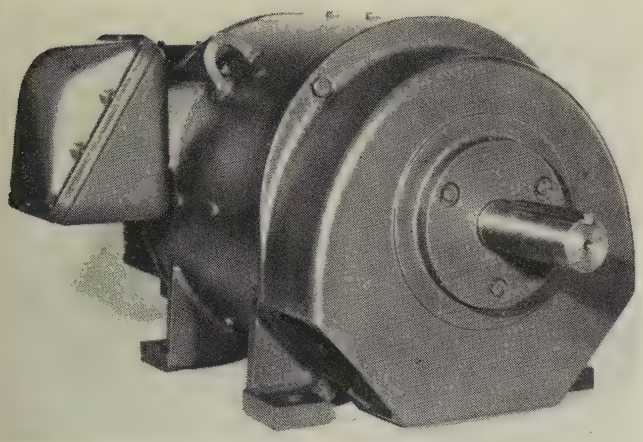
BASIC MATERIALS EXPOSITION

The Third Basic Materials Exposition will be held at Convention Hall, Philadelphia, Pa., May 31 to June 3, 1955.

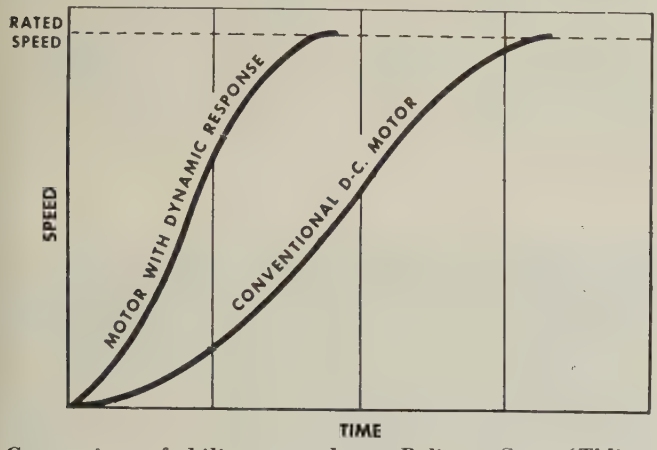
PLANT MAINTENANCE SHOW

Maintenance of paper and paper products plants will get special attention at the Plant Maintenance and Engineer-

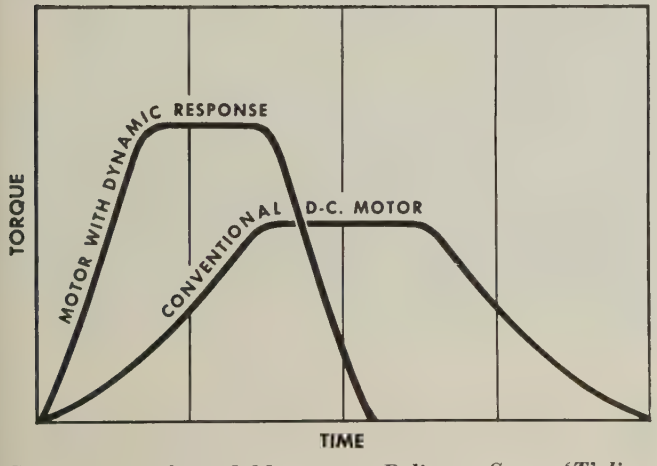
New Downingtown drier section recently placed in operation at Lowe Paper Co., Ridgefield, N. J. The 46 new 48-in. diam. driers have a 98-in. face and are arranged in a raised two-deck section



New totally protected Reliance Super 'T' line d.c. motor



Comparison of ability to accelerate Reliance Super 'T' line versus conventional motor



Comparison of available torque Reliance Super 'T' line versus conventional motor

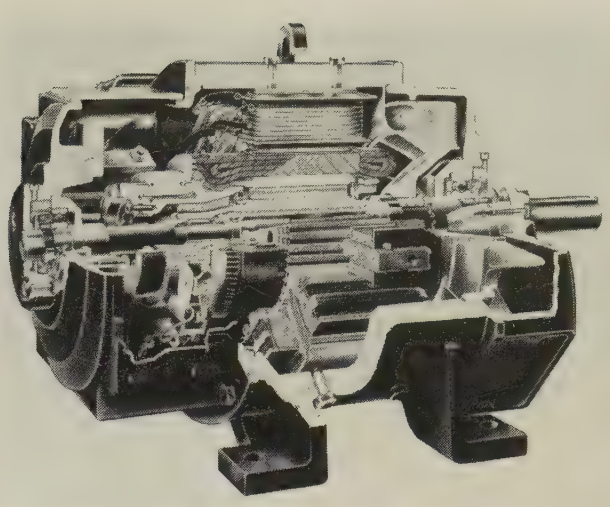
ing Conference to be held at the International Amphitheater in Chicago, January 24–27.

Production Engineering Show

The Production Engineering Show, a new industrial exposition, will be held in Chicago next September at the same time as the Machine Tool Show, Sept. 6 to 17, inclusive.

Camachine

Cameron Machine Co., Brooklyn, N. Y., has completed a new Imperial "100" winder for Bowater-Lloyd Pulp & Paper Co., Kent, England. The 276-in. winder, which has a rewind capacity of 72 in. diameter, and can operate at 5000 f.p.m., will be installed on the no. 6 newsprint machine at Bowater's Kemsley mill.



Cutaway of new Reliance Super 'T' line d.c. motor

Reliance

Reliance Electric Co., Cleveland, Ohio, has published a bulletin describing its new Super T Line industrial d.c. motors, which are claimed to have the most rapid and accurate response to a demand for change ever offered in a standard design motor.

du Pont

E. I. du Pont de Nemours & Co. has completed a laboratory for research on pigment colors at its Newark pigment plant.

Goulds

Goulds Pumps, Inc., Seneca Falls, N. Y., has published a bulletin (780.4) containing Application Data for Pumps Handling Paper Stock Suspensions.

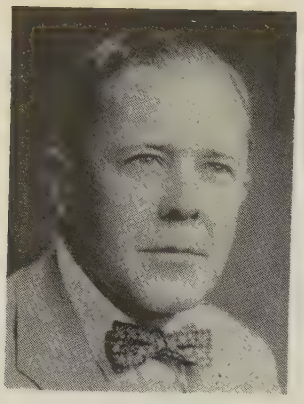
M-C & S

Merritt-Chapman & Scott Corp. has established new executive offices at 261 Madison Ave., New York, N. Y. The offices at 260 Madison continue to serve as headquarters for the company's activities in construction, marine salvage, and derrick hoisting.

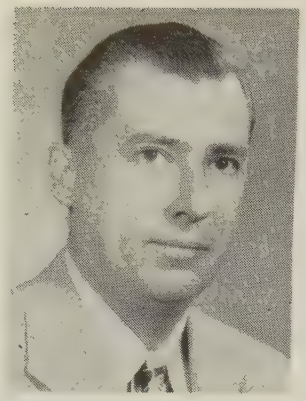
Taber

Taber Instrument Corp., Section 80, North Tonawanda, N. Y., has issued a bulletin (no. 5409) describing a new portable low-price abrasion resistance tester that will perform all the common test jobs.

The Taber portable abrasion tester with vacuum unit to remove all abrasion particles as well as complete test kit



B. K. Tremaine, Rhodia, Inc.



Kenneth Arnold, Stein, Hall & Co.

RHODIA

Breckenridge K. Tremaine has joined Rhodia, Inc., New York, N. Y., as technical director of its Industrial "Alamask" Reodorant Division.

STEIN, HALL

Kenneth Arnold has been appointed manager of the Paper Mills Dept. of Stein, Hall & Co., New York, N. Y.

CLEAVER-BROOKS

The Cleaver-Brooks Co., Milwaukee, Wis., has appointed Rex Bircket & Co., Tulsa, Okla., manufacturer's representative for the sale of C-B boiler equipment.

DRAGE VISCOMETER

Drage Products, Inc., 406-32nd St., Union City, N. J., has published a pamphlet illustrating the application of a new Swiss-made viscometer to laboratory and plant process and quality control.

BLACK-CLAWSON

Black-Clawson Co., Hamilton, Ohio, has acquired Pandia, Inc., New York, N. Y. The Pandia division will continue to supply the Pandia continuous digester and the Brammer recording consistency control and will also have a complete line of pulp mill equipment of all kinds. Tany Agronin has been appointed a vice-president of the Black-Clawson Co. and general manager of the Pandia division.

A. G. Gibson, The Black-Clawson Co.

R. C. Stewart, The Black-Clawson Co.

R. C. "Pop" Stewart has retired as southern sales representative for B-C's Shartle division, and has been replaced by R. M. "Ruey" Shetter, Jr. A. G. Gibson has been named assistant general manager of the Bagley-Sewall Corp., division of Black-Clawson at Watertown, N. Y.

NALCO

National Aluminate Corp., Chicago, Ill., has available the 1954 edition of its bulletin no. 51, giving a summary of Nalco products and activities.

NORTON

Norton Co., Worcester, Mass., has announced that it will build a new plant at Huntsville, Ala., to produce Magnorite refractory grain (fused magnesia), fused zirconia, Norbide (Norton boron carbide), and special products for the Atomic Energy Commission.

ROSS

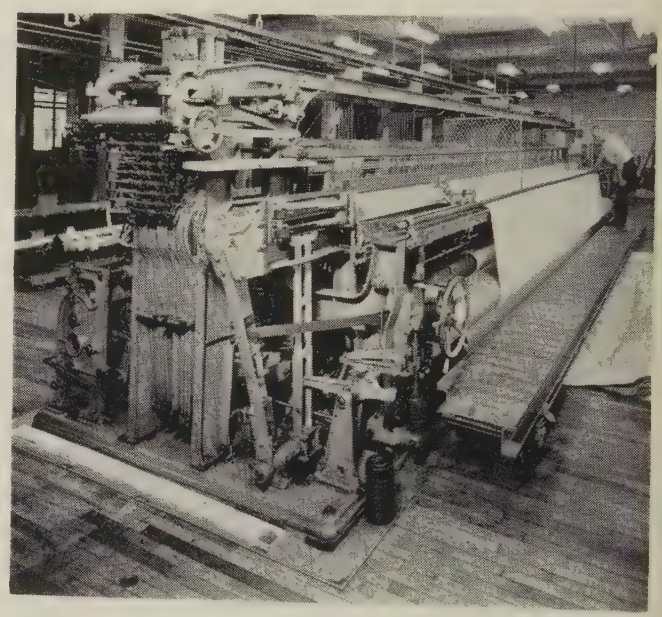
J. O. Ross Engineering Corp., New York, N. Y., has published a booklet illustrating "Some of the Newer Major Manufacturing Developments in Which Ross Engineering Has Played a Prominent Part."

SKF

SKF Industries, Inc., Philadelphia, Pa., has produced a new color sound slide film presenting their improved spherical roller bearings.

HUYCKFELT

F. C. Huyck & Sons, Rensselaer, N. Y., has installed a new



The new loom, installed by F. C. Huyck & Sons

British-made loom of special design to produce more tightly woven, firmer papermakers' fabrics.

V & W

The Babcock and Wilcox Co., New York, N. Y., has purchased the assets and business of the Globe Steel Tubes Co., of Milwaukee at a price of approximately $9.3 million.

STOWE-WOODWARD

David W. Stapleton has been appointed executive vice-president of Stowe-Woodward, Inc., Newton, Mass.

LODDING

The Lodding Engineering Corp., Worcester, Mass., has published a new catalog (G-4) on Lodding doctors.

J-M

Johns-Manville Corp., New York, N. Y., is operating two new asbestos mines at Mashaba, Southern Rhodesia, and has

officially opened a central processing mill for the two mines, with a capacity of 20,000 tons of fiber annually.

John H. Goodwin has been appointed San Francisco district sales manager of the J-M Industrial Products Division.

National Starch

R. A. Bintz has been appointed assistant director of manufacturing of National Starch Products, Inc., New York,

J. L. Edwards, National Starch Products, Inc.

R. A. Bintz, National Starch Products, Inc.

N. Y. J. L. Edwards succeeds Mr. Bintz as manager of National's Plainfield, N. J., plant, and R. W. Burdge becomes plant superintendent.

Permutit

K. G. Barnhill and E. J. Connelley have been appointed sales engineers for the Industrial Sales Dept. of the Permutit Co., New York, N. Y., in the Boston and Cincinnati offices, respectively.

Permutit has developed a new electronic control for indicating the end of the operating run of a hydrogen zeolite unit. Known as the Enditrol, the new unit compares the conductivities of the upstream sample and the effluent.

Tennessee Corp.

E. H. Shelton has been appointed general sales manager, with offices in New York, of the Tennessee Corp., L. S. Kaniecki is now manager, chemical sales, and H. G. Cunningham is assistant manager, chemical sales, with offices in Atlanta. R. W. Alexander has been appointed assistant general manager of the company's Lockland, Ohio, plant.

Carpenter

The Alloy Tube Division of the Carpenter Steel Co., Union, N. J., has published a revised catalog giving the latest information on the corrosion resistance, applications, and working characteristics of Carpenter Stainless No. 20 and 20 Cb.

F & P

The October issue of *Ratonews* published by Fischer & Porter Co., Hatboro, Pa., describes the use of F & P liquid level instruments in solving a chlorine handling problem at the Mechanicville mill of West Virginia Pulp & Paper Co.

Mallinkrodt

G. C. Bradshaw has been appointed director of sales research, W. S. Kentzer, western division sales manager, and W. F. Mitchener, assistant western division sales manager, of Mallinkrodt Chemical Works, St. Louis, Mo.

Link-Belt

Link-Belt Co., Chicago, Ill., has published a booklet (No. 2587) describing its line of screening equipment for removing solids from water, sewage, and industrial waste.

A-C

G. V. Woody has been appointed special assistant to C. W. Schweers, vice-president, director of sales, general machinery division, Allis-Chalmers Mfg. Co., Milwaukee, Wis. W. M. Wallace succeeds Mr. Woody as manager of the processing machinery department.

Hooker

E. Paul Duncan has been appointed technical service representative for the Hooker Electrochemical Co., Niagara Falls, N. Y., with headquarters at the company's Tacoma, Wash., plant.

Ingersoll-Rand

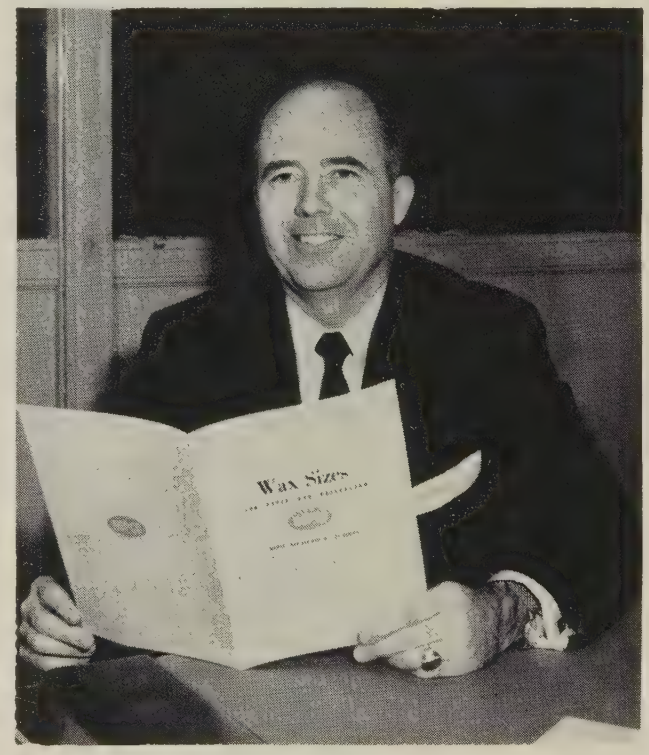
Ingersoll-Rand, New York, N. Y., has published a catalog covering its line of air and electric scraper hoists for handling bulk materials.

G.E.

C. C. Collins, a General Electric Co. applications engineer, is at present in India in connection with the start-up of India's first newsprint mill, the National Newsprint and Paper Mills Ltd., at Chandi, India.

Nopco

Nopco Chemical Co., Dept. PC, Harrison, N. J., has published a booklet describing the basic grades and applications of Nopco's wax sizes.



The new booklet describing the line of wax sizes for paper manufactured by the Nopco Chemical Co., being announced by W. B. Morehouse, assistant vice-president in charge of Nopco's Paper Chemicals Division

Nopco is producing a new polyvinyl acetate emulsion, Nopco 1572-R, which is colorless, odorless, nontoxic, and is one of the cheapest synthetic resins available.

Butterworth

H. W. Butterworth & Sons, Bethayres, Pa., has completed a new plant addition and is offering its facilities to machinery

manufacturers who want to retain their own sales organizations.

EGAN

Fran W. Egan & Co., Bound Brook, N. J., has started construction of a new plant near Somerville, N. J.

DOWELL

Dowell, Inc., Tulsa, Okla., has published a leaflet on the Dowell systems of cleaning pipes.

GRAVER

Graver Water Conditioning Co., New York, N. Y., has published a technical reprint (T-122) titled "Some Economic Aspects White Water Treatment in Pulp and Paper Mills."

OBITUARIES

Robert B. Wolf

Robert B. Wolf, 77, died of a heart attack at the Green Hotel, Danbury, Conn., on Nov. 10, 1954.

Mr. Wolf was born in Newark, Del., in 1877 and graduated as an engineer from Delaware College. He entered the pulp and paper industry in 1896 at the Hudson River Pulp & Paper Co. Following this job he was employed by the International Paper Co., Ticonderoga Pulp & Paper Co., Spanish River Pulp & Paper Co., American Wood Board Co., Union Bag & Paper Co., and the Burgess Sulphite Fibre Co.

Robert B. Wolf

In 1919 he organized the Pulp Bleaching Co. in New York City and became sales manager for the Pulp Division, Weyerhaeuser Timber Co., Longview, Wash. In 1947 he retired and became a management consultant. He held twenty patents in the pulp and paper field.

Mr. Wolf wrote a number of articles on labor and management relations. In 1942 he received the TAPPI Medal and in 1946 received the Frederick W. Taylor Key Award from the Society for the Advancement of Management.

Services were held in St. Mark's Episcopal Church in New Canaan, Conn. He is survived by his wife, Harriett; two daughters, Mrs. Margaret Wolverton and Miss Anne Wolf, and two sons, Theodore and Robert B. Wolf, Jr.

In 1919–20 Mr. Wolf was vice-president of the Technical Association of the Pulp and Paper Industry.

Joseph F. Cronin

Joseph F. Cronin, sales agent for the Cheney-Bigelow Wire Works and Tyer Rubber Co., Boston, Mass., died from a heart attack while sitting in his car at Waite, Me., on Nov. 9, 1954, while on his way to Woodland, Me. Mr. Cronin had been calling on paper mills in Maine.

Mr. Cronin was born in Brooklyn, N. Y., on Jan. 1, 1893. He was vice-president of the Cheney-Bigelow Wire Work from 1924 to 1948. He was a member of the Technical Asso ciation of the Pulp and Paper Industry.

William D. Maxim

William D. Maxim, division manager of the Northern Mills of the International Paper Co. and president of the Indian River Power Co., died after a brief illness, in the Glens Falls Hospital, Glens Falls, N. Y., on Nov. 21 1954.

William D. Maxim

Mr. Maxim was born in Wiscosset, Me., on Nov. 2, 1889. He joined the International Paper Co. as an apprentice in 1909. As division manager he supervised the International Paper Co. mills at Livermore Falls, Me., Ticonderoga, Corinth, Niagara Falls, and Tonawanda, N. Y.

He was a member of the Technical Association of the Pulp & Paper Industry.

Christopher C. Crusius

Christopher Charles Crusius, consulting mechanical engineer for Parsons & Whittemore, Inc., New York, N. Y., died after a brief illness on Oct. 21, 1954.

Mr. Crusius was born in Waldheim, Saxony, Germany, on Jan. 22, 1886, and graduated from Charlottenburg Technical College as a mechanical engineeer.

From 1912 until 1926 he was with the Crown Willamette Paper Co., Portland, Ore. From 1926 to 1945 he was an engineer for J. M. Vorth Co. in New York, N. Y., and from 1945 to 1948 he was with Industrias do Parana in New York City. In 1948 he joined Parsons & Whittemore.

Since 1929 he was a member of the Technical Association of the Pulp and Paper Industry.

Sidney Earl Meyers

Sidney E. Meyers, mechanical consultant, died in the Park Ave. Hospital, Rochester, N. Y., on Nov. 28, 1954, of cancer of the pleura.

Sidney E. Meyers

Mr. Meyers was born in Rochester, N. Y., on July 8, 1894, and entered the paper industry in 1925 as plant engineer for the Paper Board Corp., Tonawanda, N. Y. From 1927 to 1929 he was plant engineer for the Cornell Wood Products Co. in Cornell, Wis. He joined the Merritt Engineering and Sales Co. in Lockport, N. Y., in 1929 with whom he remained until 1934 when be became a design engineer for Farrel Birmingham Co. in Buffalo, N. Y. In 1937 he became chief engineer for Process Controls, Inc. in Leroy, N. Y., and since 1941 he has been self-employed as a mechanical consultant on pulp and paper equipment. He was an authority on flow control and consistency regulators.

Mr. Meyers became a member of the Technical Association of the Pulp and Paper Industry in 1929.

TAPPI DIVISIONS AND COMMITTEES

Reports of Activities

Testing Division

The following is a report of the Testing Conference held by the Testing Division of TAPPI in Dayton, Ohio, on Oct. 6 to Oct. 8, 1954.

1. A very successful Fall conference was held by the Testing Division in Dayton, Ohio, on October 6 to October 8. This conference was better attended by far than previous testing conferences and this reflects the growing interest among paper producers and consumers in the testing of paper and pulp products. There were 223 registrants for this conference, all of whom had a direct interest in the testing field. On October 7 a joint dinner meeting was held with Ohio TAPPI and the Ohio section of ASTM at which there were 267 present.

2. At this meeting it was decided to hold another Fall Testing Conference in 1955 on the tentative dates of October 5 to October 7. Holyoke, Mass., and Philadelphia, Pa., were suggested as possible locations.

3. One of the features of this last Testing Conference was the exhibit of new testing equipment. This exhibit was limited to testing equipment developed within the last two years and the exhibits were all very interesting since many of the persons attending the meeting had not seen the equipment before. There was much favorable comment from those attending the meeting on the exhibits presented by the twelve exhibitors who participated in this program. It was agreed among all committee chairmen to have another testing equipment exhibit at next year's Testing Conference.

4. At a dinner meeting of the committee chairmen the program for next year's Testing Conference was discussed. It was decided to include three sessions of papers with three separate themes to include the following: (a) new testing developments; (b) evaluation and significance of TAPPI test methods; (c) general session. The session of papers on new testing methods will be, it is expected, a regular feature of testing conferences. The session on the evaluation and significance of TAPPI test methods will be a special feature for this next conference. It will include a report on round robin testing as well as accumulated data which, it is hoped, can be obtained from individual paper laboratories. The possibility of holding a joint session with the Statistics Committee will be investigated.

5. To provide for the growing interest in testing, it was decided to set up a Steering Committee in the Testing Division which will help in formulating general plans. Membership in the Steering Committee will be selected from both the producers and consumers of paper. This committee, when formed, will meet at more frequent intervals than is possible for the working committees in the Testing Division. Regular quarterly meetings will be scheduled to discuss general topics of interest in testing. One function of the Steering Committee will be to coordinate the efforts between the various working committees, which will be more important in the future as different committees are formed based upon end use of paper products.

6. The question of increased membership and activity in the Testing Division was discussed at the last meeting. It was agreed that there was considerable latent interest in testing activities and that those people who are interested should be encouraged to actively participate in testing affairs. The suggestion was made that the New York office write the Local Sections of TAPPI and arrange for them to announce at one of their meetings an invitation for all those interested in testing to contact the chairman or secretary of the Testing Division. Also, it was decided that the consumers of paper should be encouraged to participate in testing affairs since they have a primary interest in the development of testing techniques and methods, and it is better to have these set up through the joint effort of producers and consumers rather than to have them working separately. The suggestion was made to write some of the big users of paper and invite them to become active in testing committees.

7. In addition to expanding the Testing Division through the organization of a Steering Committee, it was also suggested that a separate Steering group be set up to supervise the collection and preparation of Routine Control Methods. It was further suggested that this group give consideration to the establishment of a class of tests known as evaluation tests.

8. As part of the program for next year's Testing Conference, it was agreed that C. E. Brandon and A. Ewing would undertake to set up a round robin testing program for fine papers and kraft papers and for multiwall bags. C. A. Bicking has agreed to assist in setting up a procedure for this testing program. Also a questionnaire will be prepared for sending to all TAPPI members to uncover data available in individual laboratories on a significance of test methods. This questionnaire will be prepared very soon in order to get the program underway and completed in time for next year's conference.

9. Don Newcomb has agreed to be general program and arrangements chairman for next year's Testing Conference.

JAMES P. CASEY, *Chairman*

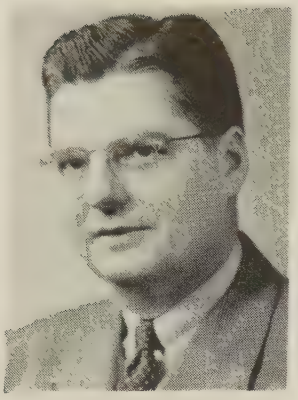
Pulp Testing Committee

A meeting of the Pulp Testing Committee was held Oct. 6, 1954, at the Testing Conference at Dayton, Ohio. Those present were:

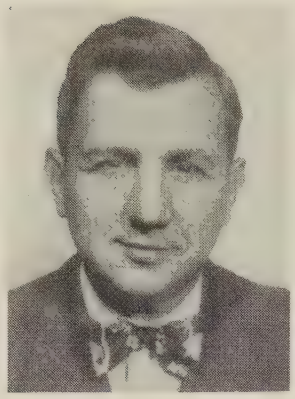
Frank Caskey, *Chairman*, Morden Machines
George Wishart, Eastman Kodak
Robert M. Wilkinson, Alton Boxboard
Ellis F. Parmenter, Champion Paper & Fiber
Norval Magnusson, Puget Sound Pulp & Timber
Herbert A. Smith, Mead Corp.
Richard Roberts, Marathon Corp.
William Elsevier, International Paper Co.
E. E. Stephenson, Sutherland Paper Co.
J. R. Arthur, Port Huron Sulfite & Paper Co.
R. H. Wiles, International Paper Co.
B. W. Burgess, Pulp & Paper Research Institute of Canada
M. C. Bode, Pulp & Paper Research Institute of Canada
F. A. Delforge, Robert Gair Co.

A progress report was made by F. A. Delforge regarding the investigation of methods for taking consistency. Following the report, a general discussion was held, in which future work was suggested. The committee felt that the consistency test should be geared to production, rather than a highly technical laboratory method. The committee also decided to use the term "consistency" indicating per cent of stock on an *oven-dry* basis as specified in TAPPI Standard T 210 m-53.

The chairman reported that the Statistics Committee had indicated the dirt count round-robin made two years ago had resulted in such wide variations that it probably would be of little value. In connection with dirt count, Mr. Roberts described a scanning device developed by Kimberly-Clark.



J. P. Casey, A. E. Staley Mfg. Co.; Chairman, Testing Division



F. E. Caskey, Morden Machines Co.; Chairman Pulp Testing Committee

In view of the fact that West Coast members live within a relatively small area, they have been conducting regular meetings on pulp testing in conjunction with Pacific Section meetings. Because of the long distances involved, Mr. Smith suggested that the whole group be broken into 2 or 3 subgroups, one in the west and 1 or 2 in the east, meeting twice a year as a composite group and in between as individual groups. Mr. Arthur suggested that these small group meetings be held along with a local TAPPI section meeting.

Mr. Caskey announced that subcommittees would be set up for special projects, each with a chairman and one or two members to at least check the results of work done by a member of that subcommittee. Projects for subcommittees include consistency, reference pulp, laboratory beater, and dirt in pulp.

With regard to TAPPI Standard T 205 (Forming Handsheets for Physical Tests of Pulp), it was suggested that making larger handsheets would allow more tests to be made from each sheet. However, Mr. Caskey quoted a report (*Tech. Assoc. Papers* 17: 463–469 (1934)) showing that handsheets made on a $6^1/_4$-in. British sheet mold were more precise than those made on an 8-in. mold. In this connection, Mr. Burgess suggested that the committee set up liaison, on British testing equipment with the British Technical Section.

A discussion was held on the question of increasing the scope of TAPPI Standards so as to include all methods of making any test, rather than just having one referee method. It was felt that this would give information and set up Standard Procedures for all members rather than just those who had the equipment described in the present Standards. If this policy is followed, correlation data should be included in TAPPI Data Sheets. The committee felt that in any event all TAPPI Standards should include a statement of why this particular method was chosen as the referee method. It was proposed that a questionnaire be sent to members of TAPPI, asking what equipment is in use in the various laboratories. A preliminary questionnaire will be sent covering Beating Equipment, Freeness Testers and Sheetmaking Equipment. Mr. Caskey pointed out that funds were available within TAPPI for Research, and added that one use could be in evaluating and correlating various types of beating equipment.

Mr. Magnusson, reporting on the status of a reference pulp, described results of a round-robin, in which 7 West Coast laboratories had run beater evaluations on dried unbleached sulphite pulp. Differences were found between laboratories and, although each laboratory had followed TAPPI Standards, this was largely attributed to interpretation of method rather than difference in equipment. Mr. Magnusson went on to describe the method of sampling and handling in order to set up a reference pulp. Mr. Caskey, who gave a paper on this project at the Testing Conference, announced that a poll of the conference showed a very definite interest in the reference pulp program. Further plans concerning the reference pulp program will be announced later.

A discussion of the Valley Beater method of pulp evaluation brought out that the biggest problem is in calibration. Mr. Magnusson described West Coast problems in grinding pointing out that Puget Sound uses "80 grit" carborundum, resulting in very rough edges, while Weyerhaeuser puts a mirror finish on the beater bars. Both of these methods have proved satisfactory in giving reproducible results but grinds in between these extremes give beater curves that are difficult to duplicate. Mr. Elsevier described a method for removing sand before evaluating a pulp in the beater. Mr. Roberts reported that I.P.C. regards fiber classification as important as strength test in pulp evaluation.

The group discussed future testing conferences and felt these should be held annually, but should not interfere with other TAPPI meetings.

The French method of moisture determination in wood pulp was discussed as a possible supplement to TAPPI methods.

Mr. Smith described the Trimbey Continuous Freeness Tester. The committee felt that this instrument would be used for routine control and should not be described in TAPPI Standards except as such.

The meeting was adjourned by Mr. Caskey with the announcement that a committee meeting will be held at the national TAPPI meeting in New York in February.

F. A. Delforge, *Acting Secretary*

TAPPI-ASTM Technical Committee on Petroleum Wax

Advisory Section and Section Chairmen

A meeting of the advisory section and section chairman of the TAPPI-ASTM Technical Committee on Petroleum Wax was held on Oct. 6, 1954, at the Dayton-Biltmore Hotel, Dayton, Ohio.

Changes in Advisory Committee Membership

Two changes were made in the membership of the Advisory Committee as follows:

To fill the vacancy in the Advisory Committee created by the resignation of A. M. Heald, it was voted to seat a member of the Marathon Corp. Subsequent to the meeting, R. W. Dannenbrink of the Marathon Corp. was named.

In the response to a letter from T. A. Howells that it was becoming increasingly difficult for him to attend Advisory Section meetings and suggesting Franz Vaurio of The Institute of Paper Chemistry replace him, it was voted to seat Mr. Vaurio as a member of the committee.

Section Chairmen

Three changes in Section chairmen were made at the time of this meeting: R. W. Dannenbrink replaced G. D. Fronmuller as chairman of Section IV on Sensory Tests, and R. W. Geiser replaced H. F. Hitchcox as chairman of Section VI on Blocking Characteristics as previously arranged. Also, T. E. Flanagan announced his resignation, due to transfer to the Kalamazoo Vegetable Parchment Co. Canadian plant, and Robert Paris of the same company was voted to replace him.

Section chairmen now occupying office are as follows:

Section I—Strength Tests: J. W. Padgett (D. R. Cushman, *Chairman-elect*)
Section II—Flow Tests: G. P. Hinds, Jr.
Section III—Stability Tests: R. P. Daniels
Section IV—Sensory Tests: R. W. Dannenbrink
Section V—Composition: J. B. Rather, Jr.
Section VI—Blocking: R. W. Geiser
Section VII—Sealing and Laminating: E. A. Yermakoff
Section VIII—Scuff and Gloss: Robert Paris

Voting Procedures

During the past six months, it became evident that the voting procedure used for ratification of new test methods by the General Committee would not meet TAPPI requirements. This is due to the large size of our General Committee, which makes it difficult or impossible to obtain the necessary affirmative vote of the total number of committee members required for approval. In the case of tentative methods, for example, TAPPI requires an affirmative vote of three fourths of the total committee members. It has been the experience of the committee that less than this proportion cast affirmative or negative ballots, since not all can be familiar with all of the methods voted on. This difficulty is not encountered in balloting for ASTM, since they make provision for non-voting members by basing their approval on the total number of yes and no ballots, in which case ballots marked "not voting" are not counted in the total.

Means of complying with TAPPI requirements had been discussed between officers of our committee and R. G. Macdonald of TAPPI. Of several means considered, establishment of the Advisory Section of the TAPPI-ASTM Technical Committee on Petroleum Wax, as the TAPPI Wax Committee, was deemed the most suitable. A favorable vote of the necessary percentage of this committee will meet TAPPI requirements, and the Advisory Committee voted to recommend to TAPPI that it be named the TAPPI Wax Committee without, in any way however, affecting the function and organization of the TAPPI-ASTM Technical Committee on Petroleum Wax. The method of voting will remain the same as before, namely, a letter ballot will be made of the General Committee, following which the ballot, together with the comments received from committee members, will be submitted to the Advisory Committee for confirmation. The results of both ballots, i.e., of the General Committee and of the Advisory Section, will be submitted to both TAPPI and ASTM. In the case of TAPPI, however, the ballot of the Advisory Section will be regarded as official.

Appropriation for Research on Gloss Determination

Appropriation of funds for development of an instrument and technique for determination of the gloss of highly glossy wax coatings had previously been requested from TAPPI, and had been held up for clarification of several details. These were recently discussed with R. G. Macdonald of TAPPI and officers of our committee, following which it seemed likely that the necessary funds would be forthcoming soon. No further action is required by our Advisory Section.

Other Matters

H. F. Hitchcox raised the question of submitting more detailed information regarding description of the test procedures under study, and results obtained by the several sections, to members of the General Committee. Currently, details of the test procedures, and results of section activities, are distributed within the sections by the section chairmen, and summaries of results distributed to the General Committee. Following discussion, in view of interest on the part of numerous members of the committee outside of individual sections in the methods and work of the sections, it was voted to submit copies of test procedures under investigation and the minutes of section meetings, to members of the General Committee. Such reports will be distributed by the section chairmen.

In view of the cost of preparing, storing, and shipping standard samples, as required in some of the test methods, it was suggested that a charge be made for all standard samples. It was agreed that this should be done, and that appropriate reference regarding charge for samples should be included in the text of methods in which standard samples are established.

Spring Meeting

The next meeting will be held in February in connection with the Annual TAPPI meeting.

Attendance: G. C. Borden, Jr., D. R. Cushman, R. P. Daniels, R. W. Dannenbrink, T. E. Flanagan, R. W. Geiser, G. P. Hinds, Jr., M. V. Hunter, H. F. Hitchcox, P. J. Metz, Robert Paris, J. S. Pettibone (ASTM), Franz Vaurio, S. T. van Esselstyn, W. J. Yates and E. A. Yermakoff.

W. J. YATES, *Secretary*

Section I—Strength Tests

J. W. Padgett—*Chairman*
D. R. Cushman—*Chairman-elect*
W. R. Turner—*Secretary*

The method of testing tensile strength of paraffin waxes submitted by Section I has been approved for publication as a Tentative Method by ASTM, and as a Tentative Standard by TAPPI. Two objections to adoption of the method as currently written had been made in the balloting of the General Committee. The first was that the use of mold release compound was not justified since it tends to lower the level of tensile strength values obtained on paraffin waxes containing microcrystalline wax. The second was that the method as written did not sanction the use of the Modified Dow Mold in addition to the Mellon Modified Perkins Mold, although both mold designs had been found suitable.

The matter of using mold release will be considered further when all the data concerning its effects have been summarized. The advisability of specifying the Modified Dow Mold as an alternate to the Mellon Modified Perkins will also be reviewed.

Results of the current round-robin test to study the effect of specimen aging time on tensile strength values were incomplete. In reviewing the data received so far, no trend was apparent among test values obtained at 1, 2, or 3 hours' aging time. It is planned to run tests extending the aging time to 16 hours to determine whether aging time is at all critical in the test. This will be done with waxes other than the two used in the round robin to broaden any conclusions reached.

Section I-B—Bending Tests

J. R. Wright, *Chairman*

Of the several bending strength tests orginally proposed, only two, the Modulus of Rupture and the Indiana Coating Index, remain under current study.

The initial round robin of the former showed poor agreement in results. It was evident from the discussion that better uniformity in test procedure is needed. The chairman, therefore, will send out a revised method for the modulus of rupture test in which the test conditions are more precisely prescribed.

Samples of wax will be distributed for a new round robin test.

Section II—Flow Tests

G. P. Hinds, Jr., *Chairman*

Since the last meeting, a procedure for determining the penetration of petroleum waxes has been published by ASTM Committee D-2 as a tentative method and has been submitted to TAPPI for publication. The members of the section have cooperated in a round robin test program designed to evaluate the reproducibility of this test method for waxes which have a penetration greater than 50 mm./10. The method as presently written is limited to waxes showing a penetration value of less than this. Results of the round robin were summarized by the chairman, and indicate that for penetration values above 50, the standard deviation of the method between laboratories increases quite rapidly amounting to 7.6 units at penetration value of 100 and 15.6 units a

150 penetration. When the load on the needle used to determine penetration is reduced from 100 to 50 grams, the standard deviation is not greatly changed at a given penetration value. The section agreed that a summary of these results would be written up and distributed to interested members of TAPPI and ASTM in order to find out if the method in its present form provides sufficient accuracy for their needs for high penetration waxes. If it does, the present values for reproducibility will be incorporated in the method, together with other minor changes suggested by Section members. If the method is not sufficiently accurate, the Section will look into other techniques for measuring the hardness of waxes in the higher penetration ranges.

Section III—Stability Tests

R. P. Daniels, *Chairman*

A revised method of test for Oxidation Stability of Paraffin Wax, using peroxide number for determining the initiation of oxidation, was approved by Section III for submittal to TAPPI for publication as a suggested method. Presentation of the method awaits minor editorial revision to conform with TAPPI format. Meanwhile, Section III is compiling additional data on the method to improve it and to establish its precision. In addition, Section III agreed to pursue the study of the fuchsin dye modification of the Oxidation Stability Method and to study other oxidation test methods which members of the Section volunteered to furnish.

Section IV—Sensory Tests

R. W. Dannenbrink, *Chairman*

The accomplishments of the section to date were discussed. It was the opinion of the section that enough round-robin tests have been conducted to adequately determine a method of preparing a wax sample for odor evaluation, either by scraping onto odorless paper or foil or into a glass jar. There was no objection to continuing tests at room temperature rather than at elevated temperature.

After discussion, the odor scale was revised. The tentative odor scale will be:

0—No odor.
1—Slight odor.
2—Moderate odor.
3—Strong odor.
4—Very strong odor.

This odor scale represents the following changes from the scale formally used by the committee:

1. No odor rated "0" rather than "1."
2. Very strong odor is added to the scale.
3. "Objectionable" and "nonobjectionable" connotations are dropped from odor description.

It was decided by the section that future tests should include microcrystalline waxes as well as paraffin.

Several details of the manner in which odor tests are conducted were discussed and agreement was reached on standardizing these details.

Future Work of the Section. The method of conducting wax odor tests will be written in the form of a proposed tentative method. A round robin test will be conducted by the Section, testing to be carried out according to this proposed procedure. This round robin is intended to accomplish the following: (1) give members a better chance to become familiar with the proposed tentative method, and to criticize it; (2) accumulate test data on microscrystalline waxes; (3) obtain reproducibility data, which have not been obtained on past tests, by repeating the test several times in each laboratory.

After the meeting, seven new members expressed their desire to participate in section activities.

Section V—Composition

C. A. Neusbaum, *Acting Chairman* (for J. B. Rather, Jr.)

Section V met in the Sheraton Park Hotel, Washington, D. C., on Oct. 6, 1954.

The precision of D 721–53 T, "Oil Content of Petroleum Waxes," was discussed. F. A. Brill distributed two memoranda prepared at his laboratory. One was a statistical analysis of previous cooperative data; the other was a new study conducted in his laboratory. He suggested that the reproducibility for oil contents under 2% be raised to 0.25%. Because of limited attendance, the matter was not put to vote. The chairman was asked to distribute Mr. Brill's memoranda to the rest of the section and to request the members to vote either by mail or in person at the next meeting as to whether precision should be raised.

The members agreed that a porosity test for filters in D 721 was needed. J. J. Watt agreed to circularize a write-up of a procedure that his laboratory had been following to check filters.

R. J. Askevold pointed out that dropping stirring from ASTM D 87, "Melting Point of Paraffin Wax," increased the time of the test. The temperature of the bath can be lowered to speed the test, as done in the I.P. method, but the committee had never tried the method under these conditions. W. R. Power mentioned that they found elimination of stirring could change results on additive waxes. F. D. Tuemmler recommended that the committee circulate some wax samples collecting precision data as well as information on the effect of stirring. Accordingly, the chairman will send out five samples of wax with a draft of a method eliminating stirring. The members will test, in duplicate, by the present and modified methods.

Cooling curve methods for melting point and congealing point versus drop melting point were brought up but, since the Section had recently considered both subjects and voted against further action, they were tabled.

The Section voted to revise T 634 m, "Melting Point of Petroleum," to bring it up to date. A draft of the method will be prepared by the chairman.

Section VI—Blocking

H. F. Hitchcox, *Chairman*
R. W. Geiser, *Chairman-elect*

The results of the recent cooperative blocking tests indicate a reproducibility of ±3°F. as compared to ±7°F. a year ago. Accordingly, the proposed blocking point test was finalized for publication. It will be submitted to TAPPI and ASTM as "Suggested" and "Information Only" procedures, respectively, in the near future.

The current data also indicate that the reproducibility is the same whether starting with the wax sample or with prewaxed paper strips. Thus, attention will be directed toward improving the accuracy of calibrating the blocking plates and rating the blocked papers. The committee will establish two "standard waxes" having sharp and consistent blocking points within the 100/105 and 120/130°F. ranges. Frequent use of these standards will serve as an additional check to insure proper blocking plate calibration. Secondly, preblocked sample strips will be prepared from two waxes presumably having "fairly distinct" blocking points. These samples will be rated by the Section to determine the agreement in selecting the blocking point with identical strips. In addition, the waxes used to make the above strips will be tested on four different days in each laboratory to determine the test repeatability.

Section VII—Sealing and Laminating

E. A. Yermakoff, *Chairman*
S. T. Van Esselstyn, *Secretary*

The chairman briefly reviewed the progress of the committee during the past year.

A tabulation of the data from the recent round-robin for measurement of sealing strength was distributed and followed by a discussion from the floor. It was the general consensus that while the agreement between laboratories was fair it could be improved upon and various means were considered.

Since the samples which were coated by one laboratory and sealed and tested by the individual labs showed better uniformity between labs, the question was raised whether the coating procedure was specific enough. After some discussion it was agreed that this phase warrants further study.

A report on seal strength, when samples were peeled at 60°, was presented by Mr. Hitchcox. In general, the variation in this method was comparable to 180° separation method. (Three labs participated in the 60° phase tests.) In peeling the sealed strips at 60° it was also shown that quick chilled samples have appreciably high seal strengths.

The committee felt that the method did not sufficiently disclose the difference between the two waxes. Methods of amplifying these differences were discussed.

If the time factor before the next meeting permits, a subcommittee, yet to be selected, will investigate the following:

(1) Coating variables.
(2) Effect of other papers to amplify differences between waxes.
(3) The effect of quick chill on different waxes.

Section VIII—Scuff and Gloss

Robert C. Paris, *Chairman*

Scuff. T. E. Flanagan, chairman, opened the meeting with the announcement of his resignation, owing to his transfer to Canada by K.V.P. Robert C. Paris of K.V.P. was named chairman in his place.

The results of the third round-robin on scuff were distributed. There were no objections to the conclusion that agreement between laboratories was poor. This was attributed mainly to the difference in scuffing blocks.

W. R. Turner of Atlantic then reported the results of his investigation concerning the electrotyping method of reproduction of the scuffing blocks. This method shows promise and the section voted unanimously to continue further along this line; the best possible material for making a master scuffing block from which blocks could be reproduced by electrotyping will also be investigated.

Shell Oil Co., Pure Oil Co., Cit-Con, and Sinclair Research agreed to investigate modification of various details of the methods which were suggested in the interest of improving its accuracy.

Gloss. The funds for the research work on gloss had not yet been approved. It was understood that this matter would be taken up by the Executive Committee of TAPPI in the near future.

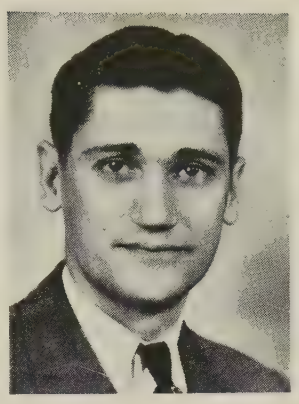
Richard Hunter of Hunterlab said briefly that he hoped to correlate commercial visual gloss ratings with reading on an instrument, and to prepare plans of this instrument. He has started to collect waxed papers of various degrees of gloss and any waxed paper producers are welcome to send in samples if they so desire.

Microscopy Committee

The Microscopy Committee held an all-day meeting on Oct. 6, 1954, in the Hotel Biltmore, Dayton, Ohio, during the Fifth Testing Conference at the same place.

Seven committee members were present. These were: C. E. Brandon, E. F. Barker, D. A. Cameron, I. H. Isenberg, H. C. Koch, A. P. Tracy, and N. F. Wilson. The group of actively interested visitors added many highly valued comments and suggestions to the discussions.

The chairman, Mr. Brandon, opened the meeting by welcoming those present and inviting the visitors to participate in the committee activities.



C. E. Brandon, Howard Paper Mills; Chairman, Microscopy Committee

Milton Yezek, General Foods Co.; Chairman, Container Testing Committee

The first topic of business was a brief report by the chairman on the status of the proposed method for the microscopic identification of paper fillers. The matter is awaiting the ballot vote of some of the committeemen.

A step-by-step discussion of Suggested Method T 445 sm-44 Identification of Specks and Spots in Paper proved to be the major item of business during the meeting. Mr. Barker presented for the discussion a preliminary revision of the method into which were incorporated the suggestions made during the meeting in New York last February. Detailed notes were made of the many suggestions and these will be processed for further committee consideration.

Mr. Simons reported by letter the progress being made in the work on the microscopy monograph. Some portions have been or are being written while authors for others are yet to be found.

It was reported that the large number of replies received to the microscopy questionnaire were very gratifying. The listed uses made of microscopes, suggestions on information needed, and the like in the replies were summarized and tabulated by Mr. Landes for a paper to be read during the conference. This summary is to be studied in detail by the committee at a later date.

The subject of fiber analysis weight factors was also one discussed in considerable detail. This discussion brought out the magnitude of the problem of rechecking present factors and determining others for additional fibers. It was agreed that it is a definitely worthy project, and a concrete program should be worked out for further consideration.

A subject suggested for future consideration was the preparation of a method for identifying kinds of printing on paper.

Time did not permit further discussions, and the meeting was adjourned.

Harold C. Koch, *Secretary*

Container Testing Committee

Following are the minutes of the Container Testing Committee meeting held at Dayton, Ohio, Oct. 6, 1954.

Those present at the meeting were:

Harold Boyd, Jr., The Hubinger Co.
Wilmer J. Balster, The Don L. Quinn Co.
James P. Casey, Staley Manufacturing Co.
M. J. Clark, Inland Container Co.
Charles H. Krebs, Atlas-Boxmakers, Inc.
C. S. Macnair, Acme Steel Co.
Ked Martin, Fort Wayne Corrugated Paper Co.
A. J. Winchester, TAPPI
Milton Yezek, General Foods Corp.

Discussions were held from 10:00 a.m. to 5:00 p.m. The meeting was opened with Mr. Krebs and Mr. Macnair reviewing the history of Container Testing Committee. The

remainder of the program centered about the scope and organization of the committee.

Immediate Scope

In the past the Container Testing Committee has attacked many and worth-while problems. These problems covered such fields as corrugated containers, multiwall bags, internal packing, revision of specifications, etc. The majority of the group felt that for this committee to be most effective, at this time it should attack only a few problems related to the corrugated container field. This suggestion was made and adopted even though the scope of the committee as originally established is more broad than this. Specifically, this scope reads in the *TAPPI Year Book:* "nomenclature, definition of terms, test methods, performance specifications and study of the effect of various factors influencing strength and serviceability relating to packaging, including packages, shipping containers and pallets, and the physical methods of testing container boards."

In choosing the objectives for the coming year, it was suggested that the committee work on problems in the corrugated container field where there is an urgent need for their solution. For the coming year the group agreed that the committee would work on standard test methods for:

1. Compression test.
2. Mullen test.
3. Flat crush test.

Organization of the Committee

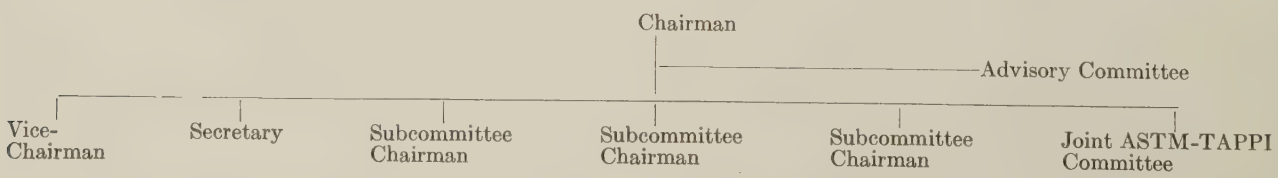
M. Yezek of General Foods Corp. was appointed committee chairman, effective Sept. 1, 1954. It was defined that it is Yezek's responsibility to appoint a secretary, vice-chairman, and subcommittee chairmen to head groups working on the three problems stated above.

It was suggested at the meeting and the suggestion was adopted that members with lesser responsibilities than those who were carrying the load of the committee work head up the various committees and the administration of the committee. Those members who have carried the load of the committee for quite a number of years could be used in an advisory capacity.

It was suggested and agreed that the organization of the committee would be made up so that there be a line of progression for automatic appointment of committee chairmen each year. Appointments will be made of vice-chairman, secretary, and three subcommittee chairmen. After one year the vice-chairman would become chairman of the committee, the secretary would become the vice-chairman, and one of the subcommittee chairmen the secretary. One new subcommittee chairman would be appointed each year. With this plan it was felt that there would be continuity of administration of the committee and not too much work load would be on any one member for an extended period.

In addition, the organization would have an advisory committee composed of members with long experience in the corrugated container field and whose responsibilities with their companies are too great to allow them to participate in the actual work of the committee. The Joint ASTM-TAPPI Committee will remain intact as shown in the 1954–1955 TAPPI yearbook.

Schematically, the organization will be as follows:



All necessary appointments will be made by Jan. 1, 1955.

Much appreciation is extended to Mr. Casey, Mr. Krebs, Mr. Macnair, Mr. Long, Mr. Clark, Mr. Martin, and Mr. Balster for their suggestions and recommendations at the Dayton meeting.

MILTON YEZEK, *Chairman*

Plastics Committee

Fibrous Materials for Laminated Products Subcommittee

A meeting of the above subcommittee took place at TAPPI headquarters, 155 E. 44th St., New York, on Nov. 4, 1954, at 10:00 a.m. The following attended:

Paul M. Goodloe, Brown Co., *Chairman*
J. J. Forsythe, International Paper Co.
J. R. Guenther, Continental Can Co.
R. W. Kumler, Foster Dee Snell
W. E. Morris, Barrett Div., Allied Chemical & Dye Co.
R. K. Newcomb, John Waldron Corp.
A. K. Sutermeister, Pasadena Hydraulics Co.
V. T. Stannett, College of Forestry *Secretary*

Apologies for absence were received from Randall Doughty and Ray Lodge.

The results of the questionnaire regarding tests for the saturation quality of paper were given and discussed. It was pointed out that the development of a satisfactory test would help (1) the laminators, (2) the paper workers, and (3) the resin manufacturers. The choice of a suitable standard resin and test was discussed on the basis of the questionnaire returns. The Borden Co. suggested a resorcinol resin solution would be the most stable and reproducible type. After considerable discussion, it was agreed that three resins, (1) a powdered phenolic, (2) a liquid resorcinol and (3) a powered melamine, would be suitable for the initial work. Three standard saturating papers (alpha, kraft, and cotton) would also be used. Temperature and humidity conditions would be regulated to TAPPI standards for evaluating the tests and later a study of the effect of changing the temperature and humidity would be made. The chief object would be to establish a sound reproducible method for measuring the rate of absorption of resins. Later methods for determining the total absorption and resin distribution would be investigated.

It was agreed that the initial testing work could best be carried out by a private testing laboratory and that their recommended method would then be evaluated by the industry. The chairman was asked to draw up the requirements in the form of a proposal recommending that money be requested from the appropriation committee to cover the cost of the testing program. The meeting terminated at 12:30 m.

V. T. STANNETT, *Secretary*

Permeability Project Steering Subcommittee

A meeting of the above subcommittee was held at the College of Forestry, Syracuse, N. Y., on Nov. 16, 1954, at 10:00 a.m. The following attended:

Fleming D. Long, TAPPI
R. T. Nazzaro, TAPPI
J. J. Uber, TAPPI
W. L. Hardy, TAPPI
E. C. Jahn, Forestry College
M. Szwarc, Forestry College
J. A. Meyer, Forestry College
V. T. Stannett, Forestry College

The meeting opened with a discussion of the reporting procedure used on the project during the past year. The com-

mittee felt that the practice of one-page monthly reports was inadequate and, on the suggestion of Mr. Long recommended that fuller quarterly reports should be submitted in the future. These should also contain a brief financial statement of the monies expended and the approximate number of man-hours spent by the personnel on the project.

The question of work to be carried out during the coming year was then discussed and the following program was adopted as suitable.

Objectives

To investigate the basic phenomena of the permeability of various gases and liquids, but especially of water vapor, oxygen, nitrogen, and carbon dioxide through polymer films and plastic treated paper. Plastic films will be studied in order to eliminate the influence of the substrate and to get basic data relative to different chemical and molecular structures. Studies will be made of polymer-paper combinations, such as laminates and coatings to determine correlation with film studies and the variations introduced by the presence of a paper substrate. Several paper types will be studied of a specified weight, such as parchment, kraft, glassine, and sulphite.

Future Plans

1. Effect of Water Vapor on Gas Transmission and vice versa. This study should include the effect of water vapor on carbon dioxide transmission and vice versa. The effect of water vapor on nitrogen and oxygen transmission and vice versa. The first year's research had covered the effects of carbon dioxide on oxygen and nitrogen transmission and vice versa and this work is now virtually complete. Suitable films for the gas-water vapor mixtures were judged to be polyethylene, cellophane, pliofilm, and mylar.

2. Effect of Structure of the Plastic Film on Gas Transmission. A special series of films are being prepared of polyvinyl acetate, polyvinyl alcohol, and a range of vinyl acetate-alcohol copolymers, all prepared from the same sample of polyvinyl acetate. These would be used to study the effect of chemical structure, cohesive energy density, etc., on gas permeability. This study can be extended to the system polyvinyl acetate, vinyl acetate-chloride copolymers, and polyvinyl chloride as and when required.

A study of the effect of cross-linking has been virtually completed but a study of the effect of varying the crystallinity would be of interest. It is proposed to study this effect using polyvinylidine chloride (Saran) coatings of various degrees of orientation.

3. The Effect of Paper Substrates. The effect of the paper substrate will be investigated using coated and laminated glassine and supercalendered sulphite and kraft as model substrates. To show the effect of the paper-plastic coating interface the gas and vapor permeabilities of coated papers of different coating thicknesses would be studied. In addition, a number of combinations such as plastic-paper-plastic, plastic-paper, and paper-plastic-paper would be investigated.

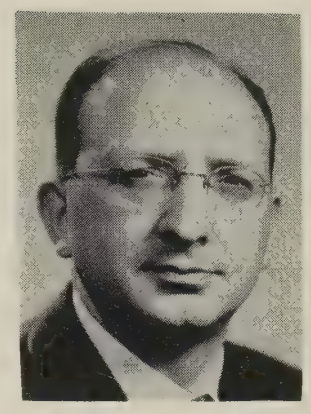
The difference in water vapor transmission of plastic coated papers according to which surface is exposed would also be investigated and the reasons for any differences studied.

The meeting adjourned at 4:00 p.m.

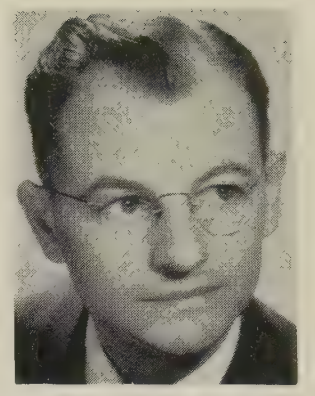
V. T. Stannett, *Secretary*

Industrial Engineering and Materials Handling Committee

The business luncheon of the Industrial Engineering and Materials Handling Committee was held on Monday, Oct. 18, 1954, in Room 244 of the Benjamin Franklin Hotel. Chairman William R. McNally, of Link-Belt Co. opened the meeting with Hank Stoess as secretary. Eight men were in attendance.



Ralph T. Nazzaro, Westfield River Paper Co.; Chairman, Plastics Committee



C. A. Young, Reigel Paper Corp.; Chairman, Drying and Ventilating Committee

Data sheets were discussed and Fred Helverson, chief industrial engineer of Crown-Zellerbach Corp., was appointed as the representative to the Data Sheet Committee.

Future subjects for the next Engineering Conference were discussed and the topics chosen were Automation, Throwing Tails Through Paper Machines, and Mill Planning. Since Automation is uppermost in the minds of most engineers and planners, it was decided to have our program for next year on this subject with a panel discussion for the discussion meeting. A definite program will be arranged for presentation to the Division at the Annual Meeting in New York.

On Tuesday, October 19, three excellent papers were presented by J. M. MacBrayne: "The Scope of Industrial Engineering in the Pulp and Paper and Allied Industries," C. J. Kusnierek, "Wood Room Refuse Fuel Handling," and Lee Cirillo, "The Application of Industrial Power Trucks in the Pulp and Paper Industry."

The discussion meeting was held on Tuesday afternoon with about 50 men present who asked many questions of the three speakers who presented their papers in the morning. This session was moderated by Bill McNally. The highlights of statements by each speaker are as follows:

J. M. MacBrayne—The function of industrial engineering in the layout of a new or expanded area is to determine that most efficient materials handling and utilization of labor is achieved. Location of instruments at Union Bag would be determined by the instrument group. Scope of industrial engineering in mill—not possible to exactly relate the number of industrial engineers to the number of employees in a plant. Union Bag has 25 industrial engineers on staff, (5000 employees) 3 in woodlands, 7 in pulp and paper, 7 in bag factory, 4 in box factory, 2 to design labor-saving devices, 1 on job evaluation, and 1 to develop better methods of measuring wood; also 5 technicians. Unions play no part in job evaluation. Suggestions for starting effective industrial engineering departments: most important is to get to know the business in the mill; develop methods improvements to show possibilities. Industrial engineer is an *engineer*, not as first called "efficiency expert"; job description is study of job to develop responsibilities and requirements involved. A very thorough training program is needed as incentives are small. This includes mill and conversion operations—we have no incentive plan in the box plant although most other box plants have.

C. J. Kusnierek—American defibrator equipment—pitch bending trouble, steam lance present, used once every four to six hours under normal operation with operation of the lance about $^1/_2$ minute duration—cloth on flat screen, Tyler woven screen mesh 0.035 by 1 in. nonstapling type of screen.

Lee Cirillo—elimination of oil drippings from various parts of truck dependent on maintenance, difficult to completely eliminate—to eliminate fast operation of lift trucks, education of drivers and passing of driver's test, lift truck like

a Cadillac, truck makers recommend speed but the individual plant safety department makes the rules—all trucks have governors—deviation from manufacturers speed will decrease economy—question of speed a relative one-speed depends on product handled—claim for liquefied petroleum gas is it eliminates exhaust gas hazard—catalytic mufflers excellent, claim as high as 2000-hour operation.

H. A. Stoess, Jr., *Secretary*

Drying and Ventilating Committee

The Drying and Ventilating Committee luncheon was held on Tuesday, October 19, at the Benjamin Franklin Hotel, Philadelphia, Pa. The following persons were in attendance for the luncheon:

Curt A. Young, Riegel Paper Co.
James M. McAlear, Mason-Neilan Regulator Co.
Anthony Cirrito, Rice-Barton Corp.
L. G. Janett, J. O. Ross Corp.
E. G. Drew, Drew Engineering Co.
R. M. Cook, Ross Midwest Fulton Corp.
Joe Wilson, Riegel Paper Co.
A. E. Montgomery, J. O. Ross Engineering Corp.
Jack Harper, Downingtown Manufacturing Co.
J. W. Hemphill, Johns-Manville Corp.
J. F. Gschwind, Ross Midwest Fulton Corp.

Curt Young announced that one new mill member had been added to the committee. This new member is Joe Wilson of Riegel Paper Co.

Curt Young then outlined plans for dividing responsibilities and work in the committee and set up the following subcommittees:

1. Data Sheet Subcommittee.
2. New Membership Subcommittee (for procurement of mill personnel).
3. Project Subcommittee.
4. Preparation of TAPPI Monograph.

Members of the Drying and Ventilating Committee were assigned to these subcommittees and given projects to be worked on and completed during the next year.

The formal talks were presented in the Ball Room by L. G. Janett of J. O. Ross Engineering Corp., and J. C. Harper of Downingtown Manufacturing Co., with an attendance of over 300.

The discussion following the talks was held Wednesday afternoon, October 20, with an attendance of over 85. The discussion centered about clarification of questions raised during the presentation of the talks and were answered very ably by both Mr. Harper and Mr. Janett. At the conclusion of the discussion session, Mr. Harper presented some three-dimensional slides of the actual installation of the hot suction press which was the subject of his morning formal talk.

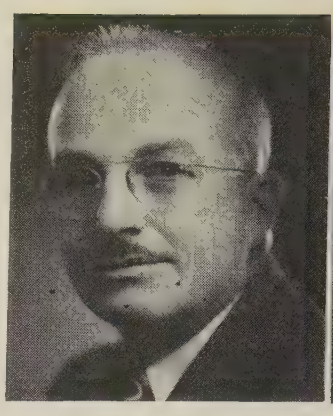
Robert M. Cook, *Secretary*

Hydraulics Committee

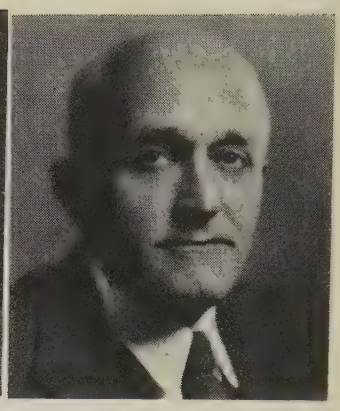
The Hydraulics Committee held its annual luncheon meeting in Room 244 of the Benjamin Franklin Hotel, Philadelphia, Pa., on Tuesday, Oct. 19, 1954, with the following members present: R. E. Durst, Victor Head, G. B. Brown, Frank R. Forrest, V. deP. Gerbereux, G. V. Shaw, J. C. Rearick, and K. J. Mackenzie.

Mr. Durst gave the committee a preview of his paper to be presented the next day which showed that definite correlation had been established between pipe friction loss and readings from the laboratory shear tester. Correlation had been definitely established for four different pulps at different consistencies and velocities.

There was considerable discussion as to how much farther this research project should be continued under TAPPI grants. The committee finally unanimously agreed that further work should be done on the following items:



K. J. Mackenzie, Eastman Kodak Co., Chairman, Hydraulics Committee



J. W. Hemphill, Johns-Manville Corp.; Chairman, Data Sheets Committee

1. A new shear tester should be built, eliminating some of the defects in the present shear tester.
2. Correlation tests should be run with at least one pulp on a pipe size different from the one that has been used. It was agreed to use an 8 in. diameter pipe.
3. Some work should be done on the relationship of freeness to pipe friction loss.
4. Some work should be done on the effect of temperature on pipe friction loss, particularly with respect to groundwood.

It was decided that the above studies should be carried on over the next two years in order to completely round out this research program. It was estimated by Mr. Durst that an appropriation of $10,000 over a two-year period would be sufficient to cover this program.

Lyle C. Jenness' resignation from the Hydraulics Committee was accepted as he is assuming the chairmanship of the Chemical Engineering Committee. He is being replaced on the Hydraulics Committee by Richard E. Durst.

K. J. Mackenzie, *Chairman*

Data Sheets Committee

The minutes of the meeting held on Sunday, Oct. 17, 1954, at the Benjamin Franklin Hotel, Philadelphia, Pa., are given below.

Present:

G. B. Brown, Johns-Manville Research Lab., Manville, N. J.
D. E. Jones, E. D. Jones & Sons Co., Pittsfield, Mass.
C. J. Meloun, General Electric Co., Schenectady, N. Y.
V. P. Owens, Combustion Engineering Co., New York, N. Y.
R. G. Quinn, Johns-Manville, Manville, N. J.
H. F. Parker, New York & Pennsylvania Co., Lock Haven, Pa.
C. A. Young, Riegel Paper Corp., Milford, N. J.
J. W. Hemphill, *Chairman*, Johns-Manville Corp., New York, N. Y.
A. J. Winchester, *Secretary*, TAPPI, New York, N. Y.

The meeting was called to order at 7:00 p.m. by Chairman Hemphill.

A lengthy discussion was held regarding the value of the work of the Data Sheets Committee. The question was raised as to whether it is really worth-while to gather together information which is already published in one form or another in various places, thus duplicating the work of others.

It was the unanimous opinion of all members present that the committee could make an extremely valuable contribution by gathering together in one place all available data applying specifically to the paper industry. Also, there is a large volume of unpublished data in the files of equipment manufacturers that could be made available to the mill engineer in the form of data sheets, thus providing a source of engineering data, not necessarily specific to the pulp and paper industry, but which is not available in the usual handbooks to which the mill engineer has access.

Mr. Hemphill outlined the progress the committee has made during the past year, and the *modus operandi* of the committee was discussed.—It was agreed that the principle of aiming toward the preparation of a handbook for mill engineers is sound, but it was strongly emphasized that the handbook outlined is merely a *guide* to insure that the data sheets we prepare will fit into an over-all pattern. It may be several years before the outline is sufficiently well filled out for the committee to consider publishing the Data Sheets in the form of a handbook.

Minutes of the meeting held on Tuesday, Oct. 19, 1954, at the Benjamin Franklin Hotel, Philadelphia, Pa.:

Present:

G. B. Brown, Johns-Manville Research Lab., Manville, N. J.
F. D. Helverson, Crown Zellerbach Corp., San Francisco, Calif.
L. C. Jenness, University of Maine, Orono, Me.
D. E. Jones, E. D. Jones & Sons Co.
C. J. Meloun, General Electric Co., Schenectady, N. Y.
J. S. Mudgett, Strathmore Paper Co., West Springfield, Mass.
P. L. Nelson, Chas. T. Main, Inc., Boston, Mass.
H. F. Parker, New York & Pennsylvania Co., Inc., Lock Haven, Pa.
W. B. Wilson, General Electric Co., Schenectady, N. Y.
J. W. Wilson, Riegel Paper Corp., Milford, N. J.
J. W. Hemphill, *Chairman*, Johns-Manville Corp., New York, N. Y.
A. J. Winchester, *Secretary*, TAPPI, New York, N. Y.

Mr. Hemphill outlined the background of the Data Sheets Committee and the progress made during the past year, including the decisions reached at the meeting on October 17.

Expanded outlines for Mr. Meloun's and Mr. Parker's sections of the handbook outline had been received. Mr. Hemphill requested that all members fill in their sections as soon as possible, as requested in his letter of July 21, 1954.

It was suggested that the chairman and secretary make up sets of the existing data sheets, arranged according to the handbook outline, and containing dividers on which the various sections of the outline would be shown. These sets would be of much assistance to the Data Sheets Committeee members in visualizing the task that confronts them.

The secretary was instructed to send a list of names and addresses of all data sheets personnel to subcommittee chairmen and members.

It was agreed that each subcommittee would undertake the preparation of at least one data sheet before the next meeting. The subjects of these sheets are to be as follows:

C. J. Meloun, Preventive Maintenance Check Lists for Motors, Generators and Switch Gear—Power Requirements of Chippers
H. F. Parker, Preventive Maintenance Pointers for Paper Machines
G. B. Brown, Friction Loss of Molten Sulphur in Pipe—Resistance of Valves and Fittings to Flow of Fluids
F. D. Helversen, Screw Conveyor Data
A. J. Chase, Revision of Existing Sheets
J. W. Wilson, Revision of Psychrometric Chart—Psychrometric Chart for Higher Temperatures
D. E. Jones, Stock Preparation
P. L. Nelson, Calculation of Steam Requirement of Digesters

In addition, Mr. Jones is to rewrite Section A-4 of the outline, and Mr. Nelson is to expand Section A-7.

A. J. WINCHESTER, *Secretary*

Steam and Power Committee

The Steam Power Committee Luncheon was held during the Ninth Annual Engineering Conference at the Benjamin Franklin Hotel, Philadelphia, Pa., Oct. 19, 1954.

The following people were present at the luncheon:

Charles Sibler, Chairman, Engineering Division
William Wyburn, Committee Chairman
Jack Gottlieb, Retiring Secretary
V. P. Owens, New Secretary
Joe Mailhos, Committee Member (new, 1954)
Nick Mailhos, Committee Member
Barry Turner, Committee Member
Dave Edmiston, Committee Member
Earl Donley, Committee Member
Bill Wilson, Committee Member
R. C. Ridings, Committee Member (new, 1954)
R. J. Chapman, Author of Paper
Walter Sogard, Committee Member
Ross Emery, Committee Member
Percy Nelson, Committee Member
George Gregg, Committee Member
R. G. Macdonald, Committee Member
Russ Knapp, Committee Member
T. F. Woodward, Substituting Martin Schnaufer
Milton Ellis, Substituting John Warner

Comments by Mr. Sibler

A new policy has been set up to include on each committee, a vice-chairman and to have definite rotation of chairmen and vice-chairmen every two or three years. The rotation of the chairmen will afford the opportunity of giving more people a chance in the leadership. The addition of the vice-chairman will make for smoother operation because of the overlap of individuals leading the committee, plus avoiding the sudden stoppage of the leadership due to resignations, illness, etc.

Mr. Wyburn announced that Walter Hall had requested to be released from the Data Sheet Committee due to a pile-up of work. Mr. Nelson has been appointed as the new chairman of the Data Sheet Subcommittee. Because Walter Hall was unable to attend the Philadelphia meeting, the writer attended the Data Sheet meeting held on Sunday evening, October 16. At this meeting, the consensus of opinion of the various representatives was that the Data Sheet project was a very worth-while one and since it is expected to be along and a hard task, that definite accomplishments will not be realized within the next few years. The writer has been relieved of this assignment to the Data Sheet Subcommittee because of being assigned as the committee secretary and it is anticipated that Percy Nelson will appoint a replacement on his subcommittee.

Discussion of Topics for Next Year

Letter 6 sent out by Jack Gottlieb on October 14 included the suggested subjects for papers, round table and long-range projects for 1955. To this list was added the following two subjects:

1. "Mechanics of Drum Internals and Steam Generators," suggested speaker, P. B. Place, Combustion Engineering, Inc. Suggestion made by V. P. Owens.
2. "Study of Boiler Specifications and Selections Based Upon Initial Low Pressure and Future High Pressure Operation." Suggested by Mr. Nelson.

A discussion was held on the importance of specifications for power plant equipment. "Specifications for Boilers" has been listed under long-range projects for the past few years, and the general feeling seemed to be that this is a good subject for data sheets. Such sheets would be of invaluable aid to power plant engineers when it became necessary to ask for bids on equipment. This subject was turned over to the Data Sheet Subcommittee for their study.

Ralph Sogard's subcommittee on the long-range project, "Power Plant Construction Report," reported that the final draft of the questionnaire was now being prepared. It is anticipated that this will be forwarded to Bill Wyburn for discussion with the TAPPI office in New York regarding plans for mailing to mills and manufacturers.

The results of the voting on subjects for the 1955 meeting follows

Main Papers

The tabulations of the committee members' choice for papers for the 1955 conference show the two following papers to be the most popular:

1. "Maintenance Procedures for Preventive Scheduled Outages and Forced Outages of Power Plant Equipment."
2. "Methods of Burning Waste Sulphite Liquor."

The first topic shown received a total of eight votes.

The second topic received a total of seven votes.

The next highest was three papers with a total of three votes, and remaining subjects received either two, one, or no votes. No suggestions were made as to authors for these papers and we would appreciate any suggestions from the committee members.

Round Table

The voting for the round-table subjects showed a maximum of four votes on the subject of "Boiler Corrosion."

The second most popular with three votes was "Operating Experiences in Power Plants for High Pressures and Temperatures." Our previous decisions made at the Pittsburgh meeting last May was that we would set up a perpetual program on equipment operational problems.

In all probability, we will follow through next year with the subject, "Corrosion in Furnaces, Boilers, Economizers, Air Heaters and Flues."

Long-Range Projects

The long-range planning selections were overlooked by more than one third of the committee members. Four people did indicate the topic, "Specifications for Equipment," and three people indicated, "Steam and Power Consumption." As we discussed at our luncheon, we are turning over the subject, "Specifications for Equipment" to the Data Sheet Subcommittee for their consideration.

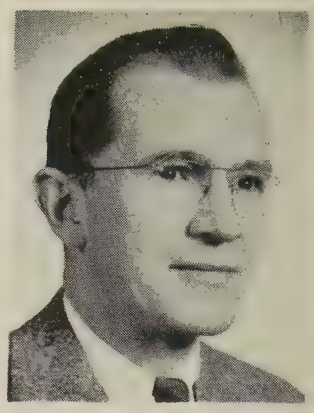
A vote taken on the preference for a general meeting of the Steam and Power Committee at the National TAPPI Meeting in New York in February, or at a special day meeting at the Pittsburgh airport, similar to last year, favored another Spring Pittsburgh meeting. Plans for the next meeting of the committee will be announced at a later date.

Membership of the Steam and Power Committee is as follows:

W. M. Wyburn, *Chairman*, Federal Paper Board Co., Bogota, N. J.
V. P. Owens, *Secretary*, Combustion Engineering Co., New York, N. Y.
H. R. Arnold, Mill Engineer, Riegel Carolina Corp., Acme, N. C.
Marvin H. Dixon, Power Engineer, Celotex Corp., 120 S. La Salle St., Chicago, Ill.
H. R. Emery, Plant Engr., St. Regis Paper Co., Deferiet, N. Y.
D. C. Edmiston, Southland Paper Mills, Inc., Lufkin, Tex.
J. Gottlieb,* Steam Power Engr., Westinghouse Electric Corp 40 Wall St., New York 5, N. Y.
G. B. Gregg, Power Engr., P. O. Box 960, The Cincinnati Gas & Elec. Co., Cincinnati 1, Ohio
Walter H. Hall, Gen. Engr. Dept., The Mead Corp., Chillicothe, Ohio
Earl Donley,* The Babcock & Wilcox Co., 161 E. 42nd St., New York, N. Y.
R. V. Knapp, Power Engr., Mosinee Paper Mills Co., Mosinee, Wis.
J. Mailhos, Plant Engr., National Container Corp., Valdosta, Ga.
N. H. Mailhos, Supt. Power, Brunswick Pulp & Paper Co., Brunswick, Ga.
R. G. MacDonald, Maint. Supt., Ecusta Paper Co. (Div. Olin Ind.), Pisgah Forest, N. C.
P. L. Nelson,* Chas. T. Main, Inc., 80 Federal St., Boston 10, Mass.
V. P. Owens,* Combustion Engineering, Inc., 200 Madison Ave., New York 16, N. Y.
Robert C. Ridings, Container Corp. of America, Manayunk, Pa.
M. F. Schnaufer, Chief Engr., Detroit Sulphite Pulp & Paper, 9125 W. Jefferson Ave., Detroit, Mich.
R. H. Sogard, Plant Engr., Escanaba Paper Co., Escanaba, Mich.
B. M. Turner, Ch. Engr., International Paper Co., 220 E. 42nd St., New York 17, N. Y.
J. E. A. Warner, Ch. Engr., Robert Gair Co., Inc., 155 E. 44th St., New York 17, N. Y.
W. M. Wyburn, I/C Engineering, Federal Paper Board Co., Inc., Bogota, N. J.

* Mfg. and consulting eng. representative.

W. M. Wyburn, Federal Paper Board Co.; Chairman, Steam and Power Committee



R. G. Quinn, Johns Manville, Chairman, Engineering Research and Machine Design Committee

H. B. Wallace, Jr.,* Foster Wheeler Corp., 165 Broadway, New York 16, N. Y.
W. B. Wilson,* Ind. Pr. Div., Room 510, Bldg. 2, General Electric Co., Schenectady, N. Y.

V. P. Owens, *Secretary*

Engineering Research and Machine Design Committee

The meeting was called to order by R. G. Quinn, chairman, at 1:30 p.m. on Monday, October 18, at the Benjamin Franklin Hotel in Philadelphia, Pa.

Mr. Curtis reported that the program was ready for presentation on Tuesday afternoon.

Mr. Brenner reported that additional work on study of rubber-covered rolls was planned and several articles would be translated from Swedish for future consideration.

The Subcommittee on Centralized Control of Stock was disbanded and the project discontinued because it was considered too broad a project.

In past meetings we had discussed the possibility of investigating lubricating systems, however, at this time it was decided to discard this as a committee project.

At the February meeting of TAPPI the Engineering Research and Machine Design Committee will sponsor a paper on the Sulzer Suction System.

The program for the October, 1955 meeting will include an additional paper on noise abatement and possibly a paper on clutches and couplings used in the paper industry.

The meeting was adjourned at 2:30 p.m. and was attended by the following:

L. A. Moore, Black-Clawson, Hamilton, Ohio
J. C. Harper, Downingtown Mfg. Co., Downingtown, Pa.
G. H. Spencer, Torrington Co., Torrington, Conn.
C. E. Macklem, Beloit Iron Works, Beloit, Wis.
J. D. Lyall, Armstrong Cork Co., Lancaster, Pa.
L. J. Tarbell, Bird & Son, Inc., East Walpole, Mass.
F. W. Nienow, Marathon Corp., Menasha, Wis.
G. E. Clink, Sandy Hill, Hudson Falls, N. Y.
S. W. Widmer, Jr., Torrington Co., South Bend, Ind.
R. C. Berger, General Electric Co., Cleveland, Ohio
H. G. Ingraham, Chas. T. Main, Inc., Boston, Mass.
E. A. Crawford, Continental Paper Co., Ridgefield Park, N. J.
J. McPherson, Mosinee Paper Co., Mosinee, Wis.
M. B. Newell, Ecusta Paper Corp., Pisgah Forest, N. C.
J. H. Gordon, J. H. Home & Sons Co., Lawrence, Mass.
D. E. Jones, E. D. Jones & Sons Co., Pittsfield, Mass.
K. W. Brenner, Eastman Kodak Co., Rochester, N. Y.
R. M. Leighton, Stowe-Woodward, Inc., Newton Upper Falls
J. R. Curtis, Scott Paper Co., Chester, Pa.
M. N. Davis, Kimberly Clark Corp., Menasha, Wis.
E. S. Skinner, Beloit Iron Works, Beloit Wis.
R. H. Reynolds, Rayonier, Jesup, Ga.
R. G. Quinn, Johns Manville, Manville, N. J.
R. D. Irwin, M-H Reg., Brown Div., Philadelphia, Pa.

Mill Planning and Economics Committee

The Ninth Engineering Conference of TAPPI was opened on October 18 in Philadelphia with the Mill Planning and Economics Session. The first paper was delivered by John A. McPherson, Mosinee Paper Mills Co., Mosinee, Wis., and Harold G. Ingraham, Chas. T. Main, Inc., Boston, Mass. This paper dealt with the rebuilding of a paper machine at the Mosinee Paper Mills Co. The authors presented in some detail the decisions which prompted them to rehabilitate an old machine rather than install a new one.

The pros and cons of rebuilding an old machine over a new machine were presented with the factors which influenced their final decision to rebuild the existing machine. Some of the most interesting points brought out were those dealing with the gathering of a suitable number of skilled laborers, and the meeting of some of the difficult construction problems such as those concerning the installation of the foundation to accommodate the changes in the machine structure.

The second paper was entitled "Methods of Preparing and Presenting Requests for Project Approval" and was delivered by Earl K. Murphy, Rayonier, Inc., New York, N. Y. Mr. Murphy stressed the economic factors which are most important in properly presenting an engineering project for management scrutiny. Mr. Murphy went into some detail on the form such a report should take so that it would be most convenient for management appraisal and so that it would allow management to come to a logical conclusion.

Members present:

P. A. Forni, Troy, N. Y.
M. C. Celli, McKeesport, Pa.
S. H. Grimnes, Plattsburg, N. Y.
R. G. Seip, Pensacola, Fla.
Allan Hyer, Watertown, N. Y.
Milton Jacobs, Boston, Mass.

On Monday afternoon a panel session was held dealing with the paper: "Paper Mill Rehabilitation Involving Rebuilding Old Machines Vs. New Machines." The panel was made up of the following members:

Sverre H. Grimnes, Diamond Match Co., Plattsburg, N. Y.
Allan Hyer, Bagley & Sewall Div., Black-Clawson Co., Watertown, N. Y.
John A. McPherson, Mosinee Paper Mills, Mosinee, Wis.
Harold G. Ingraham, Chas. T. Main, Inc., Boston, Mass.
Russell G. Seip, St. Regis Paper Co., Pensacola, Fla.
P. A. Forni, Mohawk Paper Mills, Inc., Cohoes, N. Y.

It was felt that this was a very successful panel discussion of the subject involved with standing room only. During the session many interesting and novel points were contributed also by persons in the audience regarding important factors which may influence a decision on a new machine versus rebuilding an old one.

During the committee luncheon on Tuesday noon, the committee discussed possible papers for the 1955 session. It was felt that in view of the great interest created in our first paper this subject should be continued for next year with the presentation of the opposite side of the picture, that is, an actual case history showing the factors which would influence management's decision toward the selection of a new machine over the rebuilding of an old one.

Continuing along with the same line of reasoning it was also felt that the second paper should present the one factor which may be most influential on management decision and that is a comparison of the tax structure for the modernization of an old machine as opposed to buying a new one. The committee has decided to contact various individuals in this regard so that we might present an authority in this field for next year's session.

P. A. Forni, *Chairman*

Chemical Engineering Committee

Minutes of Chemical Engineering Committee meeting held during the Ninth TAPPI Engineering Conference at the Hotel Benjamin Franklin, Philadelphia, Pa., Oct. 19, 1954.

Nicholas Shoumatoff, West Virginia Pulp & Paper Co.; Past Chairman, Corrosion Committee

J. R. Lientz, Union Bag & Paper Corp.; Past Chairman, Chemical Engineering Committee

Members in attendance: J. R. Lientz, *Chairman*, N. Shoumatoff, *Chairman*, Subcommittee on Digester Corrosion, H. O. Teeple, *Secretary*, S. J. Baisch, R. A. Davis, E. W. Hopper, F. E. Hutton, L. C. Jenness, C. L. Keene (for H. M. Canavan), E. W. Keith, J. E. Maxon (for Beaumont Thomas), J. E. Meadows (for C. W. Smith), A. R. Meyer, W. B. Parker, R. V. Pennington, H. F. Peters, W. J. Shelton, and L. A. Williams.

Guests: R. G. Macdonald, *Secretary*, TAPPI, C. H. Rimmer, CPPA liaison member, Wm. H. Funk, and J. B. Morrison.

J. R. Lientz called the meeting to order at 12:25 m. and introduced the committee members and guests. He then announced certain changes in the organization of the Chemical Engineering Committee:

1. J. R. Lientz was relinquishing the post of committee chairman and Lyle C. Jenness was to be the new chairman, with H. O. Teeple staying on as secretary until another secretary could be appointed.
2. The Subcommittee on Digester Corrosion was to be given full committee status. N. Shoumatoff, chairman of the subcommittee, was resigning and S. J. Baisch was to be the chairman of the new committee, which is to be known as the Corrosion Committee. H. O. Teeple will be secretary of this new committee.

Mr. Lientz then announced, in liaison with Lyle Jenness, that the Chemical Engineering Committee will present three papers at the Annual TAPPI Meeting in New York next February.

Mr. Shoumatoff described, briefly, the work which the Digester Committee has done during the past five years. This included the presentation of some 30 papers, three TAPPI sponsored research projects, and a monograph on "Inspection of Digesters." He outlined the remaining current projects, one of these being the presentation of a paper presenting a summary of the work of the subcommittee during its five-year existence. Along these lines, H. O. Teeple outlined the progress made with the Regional Program. This new program is based upon the use of the TAPPI Monograph on "Inspection of Digesters," and will provide for a periodic evaluation of corrosion of alkaline digesters. Eleven regional representatives have been appointed from the committee mill membership on a geographical basis. These are:

Region A, J. R. Lientz; Region B, R. V. Pennington; Region C, J. J. Goss; Region D, C. W. Smith; Region E, G. H. Kettering; Region F, E. L. Dozier; Region G, N. Shoumatoff; Region H, S. J. Baisch; Region I, (to be announced); Region J, W. J. Shelton; Region K, E. W. Keith.

In general, the response to this new program has been quite gratifying to the committee.

Eighty invitations to participate in the program were sent out and 49 replies were received. There were 47 mills accepting, 11 mills unable to accept, and 22 mills not replying. The breakdown is as follows:

Mills	*% of total*	*No. of digesters*	*% of total*	*Daily pulp tonnage*	*% of total*
47 "yes"	59	391	55	18,540	57
11 "no"	14	140	20	8,087	25
22 "no reply"	27	178	25	5,820	18
80	100	709	100	32,447	100

While this tabular summary may not be completely accurate with respect to the number of digesters and daily tonnage, it is indicative of the interest of the mills.

This program is being put into operation at this time and the mills are being advised by letter.

Mr. Shoumatoff discussed, briefly, the need for complete liquor analyses and mentioned liaison work along these lines with the Alkaline Pulping Committee.

S. J. Baisch then outlined the scope of the new committee, which is as follows:

Scope of TAPPI Corrosion Committee

The membership of the TAPPI Digester Corrosion Committee in 1952 decided that as a long-range project corrosion problems in equipment other than digesters should be considered and this decision culminated in the formation of the TAPPI Corrosion Committee which, during the October Engineering Conference in Philadelphia, was voted full committee status.

It is believed that many opportunities exist in the pulp and paper industry to improve the performance of metals and to reduce existing corrosion. To single out these opportunities it will be necessary that the functioning committee obtain scientific data and industrial experiences and, in turn, to give this information out in the form of published papers.

As is customary one of the first activities of the newly formed committee will be to survey the committee membership for suggestions of corrosion subjects believed to be the most important in the pulp and paper industry. From the survey a definite schedule of activities and possible research project will develop.

Cooperation and liaison between the Corrosion Committee and other related groups will continue. It is expected that some overlapping in activity may take place but by cooperation and discussion this will be minimized.

It is expected that the work of the TAPPI Corrosion Subcommittee will continue, especially from the regional viewpoint, since the program has been so widely accepted by kraft mills in all sections of the country.

He also outlined a program, in liaison with N. Shoumatoff, for the February meeting of TAPPI. There will be three papers, including the 5-year comprehensive report, mentioned above. Plans were also outlined for the Engineering Conference in Houston next Fall. There were a number of other considerations which Mr. Baisch enumerated, largely having to do with future work of the committee.

As of the present, membership lists of these new committees are as follows:

Chemical Engineering Committee

Lyle C. Jenness, *Chairman*
H. O. Teeple, *Secretary*
S. J. Baisch
R. E. Bergstrom
Andrew J. Chase
J. J. Goss
J. H. Hull
J. R. Lientz
Marcy B. Newell
C. H. Rimmer (liaison with CPPA)
N. Shoumatoff
R. P. Whitney

Andrew J. Chase is the Data Sheets Committee representative

Corrosion Committee

S. J. Baisch, *Chairman*
H. O. Teeple, *Secretary*
P. K. Bloch
H. M. Canavan
C. B. Christiansen (liaison with PPRI)
R. A. Davis
E. L. Dozier
J. J. Goss
E. W. Hopper
F. E. Hutton
E. W. Keith
G. H. Kettering
J. R. Lientz
A. R. Meyer
W. B. Parker
R. V. Pennington
H. F. Peters
M. A. Scheil
W. J. Shelton
N. Shoumatoff
C. W. Smith
B. Thomas
R. P. Whitney
J. M. Wilcox
L. A. Williams

The Data Sheets Committee representative is to be announced. Temporary representative is H. O. Teeple.

Messrs. Lientz and Shoumatoff expressed thanks for the help of the committee members during their terms of office. Messrs. Jenness and Baisch asked for assistance from the committee in carrying out their new assignments as each was anxious to render good service to the pulp and paper industry.

H. O. Teeple, *Secretary*

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REPORTS AND DISCUSSIONS

Presented at the National and Regional Conferences

Semichemical Pulping

THE following are brief introductory remarks which preceded the panel discussion at the Alkaline Pulping Conference, Birmingham, Ala., Oct. 8, 1954.

INTRODUCTION—C. W. CONVERSE

The theme of this meeting is "A Survey of Semichemical Pulping Unit Operations." It will consist of 10-minute talks by experts in each field covered. After the talks, the meeting will be open to questions directed to the speakers.

All of us gathered here are interested in semichemical pulping, the newest of the pulping processes. The production of semichemical pulp exceeded 1 million tons in 1953, surpassing that of the following grades: alpha and dissolving grades, unbleached sulphite, semibleached sulphite, and soda pulps.

In contrast, the production in 1945 was about 300,000 tons per year, and that purely for corrugating board. Now, an increasing amount of bleached semichemical pulp is used in such grades as book, printing, bond, writing, coating base stock, newsprint, and many others. In fact, it is not an over statement to say that semichemical pulp can be the chief constituent of most papers now made with sulphite as well as many made with kraft.

That there is steady growth in semichemical pulp production for corrugating board manufacture is obvious, and continuation of this expansion is assured by the favorable growth factor of the container industry. The determination of Canada to shut off pulpwood shipments to the United States is another factor of importance in northern mills, and one which has a particularly favorable influence on the development of bleached pulp manufacture.

Within the past few days, a study of the future of the pulp and paper industry, made by the Stanford Research Institute has been released by Weyerhaueser Timber Company, the sponsoring firm. It is encouraging to those of us who have long championed semichemical pulp to read that the production of this pulp is expected to rise to 5.2 million tons by 1975. This means an increase of 500% in the production of semichemical pulp. This expansion assures us of a steady increase in the use of the untapped raw material resources which surround many of our mills, namely the deciduous species. In most areas the current usage of the deciduous or hardwood species does not keep pace with their annual growth. These hardwood resources guarantee that our wood supply for semichemical pulping will always be adequate. In turn, semichemical pulp is proving a desirable furnish ingredient for a wide variety, if not indeed, the majority of paper and board grades. Its usage, bleached, will be of particular interest to eastern and northern nonintegrated mills which must now purchase their pulp from mills far distant from their own.

This is a young branch of the pulp industry, and one whose mill design is by no means stabilized. It is about the unit operations in semichemical pulping that we are to hear this afternoon, from the following panel members:

W. J. Zimmerman, chief project engineer, Parsons & Whittemore, Inc., New York, N. Y., "Wood Preparation"

K. L. Kirven, pulp mill superintendent, Sonoco Products Co., Hartsville, S. C., "Cooking—Rotary Digesters"

W. W. Marteny, technical director, National Container Corp. of Wisconsin, Tomahawk, Wis., "Cooking—Continuous Digesters"

Joseph F. Keyes, assistant pulp mill superintendent, North Carolina Pulp Co., Plymouth, N. C., "Cooking—Vertical Digesters"

C. W. Converse, manager, Pulp & Paper Mill Division, Sprout-Waldron & Company, Inc., Muncy Pa., "Refiner Feeding Systems"

J. E. Sapp, technical assistant to board mill superintendent, Gaylord Container Corp., Bogalusa, La., "Refining"

A. L. Wiley, assistant to production manager, Riegel-Carolina Corp., Acme, N. C., "Washing"

D. J. MacLaurin, chief, Pulping and Paper Making Section, Institute of Paper Chemistry, Appleton, Wis., "Bleaching"

L. W. Murtfeldt, pulp superintendent, Wisconsin Rapids Division, Consolidated Water Power & Paper Co., Wisconsin Rapids, Wis., "Corrosion in Neutral Sulphite Semichemical Pulp Mills"

DIFFICULTIES ENCOUNTERED IN BARKING AND CHIPPING HARDWOODS—W. J. ZIMMERMAN

This subject is presently one of primary importance, which has been rather taken for granted and written over in most approaches, yet is not completely solved to the point where a definite standard practice has been adopted.

The standard drum barker, used almost universally for softwoods, has been accepted although it has its limitations when employed to barking certain hardwood species. In North America these species consist of aspen, basswood, beech, birch, cottonwood, maple, oak, poplar, black and red gum, etc. We also have a vast and comparatively untapped supply of tropical hardwoods to contemplate in the consideration of this subject.

The attractiveness of drum barking lies in that it employs the "mass barking" principle as opposed to the "unit log barking" principle employed by hydraulic stream barkers or in-line mechanical debarkers. Drums also have large unit capacity and relatively low horsepower per cord consumption, particularly when operating on softwoods.

When dealing with some of the hardwood species these advantages are nullified to a large extent. Disadvantages appear such as wood damage, loss of capacity, and excessive "brooming" causing wood losses.

As an alternate to drum barking we have available to us the hydraulic stream barker which was developed on the West Coast and primarily for large diameter logs. Its disadvantages appear when employed on our eastern pulpwood of small diameter. Also, to create the high stream pressures necessary for barking hardwoods it requires a relatively high horsepower per cord consumption.

We also have available several types of mechanical debarkers or rossers to choose from in consideration of this problem. Although lower in power requirement, their disadvantage lies in the "in-line" design, restricting their unit capacity for large production wood handling. This affects handling small diameter eastern pulpwood.

On the whole it is felt that the ultimate success in debarking hardwoods advantageously presents an attractive challenge for improvement to the design engineers.

Recently interest has been attracted to chemical barking. This has been successfully done by the use of sodium arsenite.

On the standing tree, the bark is bumped off near the base with the blunt back of a single bit ax. The sodium arsenite is applied with a paint brush to the scarred area shortly thereafter. The chemical is carried through the sap stream into the upper tree and is absorbed in about 24 hr. This treatment should be made only in the growing season, that is from full leaf time until fall leaf time. It is recommended that the tree be allowed to stand over winter before cutting to assist the chemical reaction.

The chemical kills the wood cells in the cambium layer, and the cells are further ruptured by the combined freezing and thawing in the winter months. This rupture breaks the bond between the wood and bark, loosening the latter so it is easily removed.

It is alleged that this practice does not endanger wild-life and no repercussions have occurred where it has beem employed for years. An experienced crew of four men can treat 100 to 150 cords per day, depending upon the volume in the stand.

This method is pointed out as a possible practical approach to be where hardwood bark removal problems are encountered and found difficult.

Some tropical hardwoods have a high silicon content, the presence of which creates a rugged duty on chipper knives, saws, and mechanical barkers. Such problems are not encountered with our temperate zone hardwoods, but improvements can be made in design and adaptation use of our chip preparing equipment.

"Semichemical" pulping generally, to obtain high yields from wood by retaining the useful hemicellulose constituents in the pulp, might also be termed "semimechanical" pulping.

When viewed thus, we might advocate putting more of the mechanical work on the chipper to relieve, or utilize more advantageously, the later mechanical pulping done by the customary attrition mills.

This and other advantages could be obtained by selective emphasis on chip quality. Digester time could be reduced by the adaptation of smaller chip sizes, thereby shortening the impregnation period.

Presently chips of $^1/_2$ to $^5/_8$ in. are used. In advocating the use of $^1/_4$ to $^3/_8$ in. it may well be that the absorption of the cooking chemicals into the chips would be more uniform and total impregnation obtained faster.

To obtain uniform chips of this or smaller size entails changes in the present design of chippers, and again presents an attractive challenge for improvement to design engineers.

By the challenges, our pulping methods progress.

A Rotary Digester System of Semichemical Pulping—K. L. Kirven

These are observations from a general practice of cooking gum wood, a so-called soft hardwood; remarks based on experience with 15 ft. rotary globe digesters and producing a high yield pulp for corrugating medium

This neutral sulphite cook may be briefly described. The chips are steamed, charged with a cooking liquor containing sodium sulphite and sodium bicarbonate, subjected to the action of live steam until most of the chemical has been consumed; then the pressure relieved, the steam carrying with it the spent liquor not absorbed by the chips. The chips remain in a solid state until subjected to mechanical defiberization.

The objective of presteaming is that of preparing the chips for quick, complete penetration of the liquor which is to follow. The displacing of air and heating of the chips lends itself to uniformity of penetration by increasing the vacuum action inside the chips as well as absorption by osmotic pressure and diffusion. Green chips, or chips with a high moisture content, steam more uniformly over the same period of time than do dry chips where the steam has a tendency to rush through the digester.

An excess volume of cooking liquor is needed to assure the necessary amount of chemical available to each chip. The liquor charge may be adjusted in accord with determinations of actual weight of wood. It is of extreme importance that the liquor be of uniform concentration. This can be insured by proper circulation. Failure in uniformity of penetration produces irregularities in the pulp. The penetration should occur rapidly and the pressure raised as soon as possible to maximum. The digester should rotate to assist in a more even distribution of liquor and steam.

The chemical requirements per ton of pulp are as variable as the conditions of wood previously mentioned. A 10 to 12% figure is rough average, based on a 75% yield. In the liquor, the quantity of buffer must be sufficient to neutralize the organic acids encountered in the chips themselves before and after refining. In using sulphite liquor, some of the sodium salts are effectively using in buffering. Most generally they are the bicarbonate, carbonates, or hydroxides.

The rate of reaction between the sodium sulphite and lignin increases with the rise in temperature very sharply and can be well shown by a graph of time versus temperature and sulphite consumption. It is unnecessary to determine periodically the amount of sulphite remaining during the cook for control purposes, once a cooking time has been established. The liquor blown from the digester contains 14 to 15% solids, the principle constituents being sodium lignosulphonate and sodium acetate.

Cooking—Continuous Digesters—W. W. Marteny

In considering a pulping reaction there are several laws that apply regardless of the equipment used. Consequently, I will enumerate several of the variables normally considered in defining a pulping operation:

1. Liquor to wood ratio: Any desired liquor to wood ratio may be used in continuous equipment because there is no definite consistency needed. In our case we use a very low ratio of 2.3 lb. of water per lb. of oven dry wood.

2. Chemical charge: As we all know, sufficient chemical must be added to obtain the desired properties in the pulp. Most mills manufacturing pulp for corrugating medium use low charges to obtain high yields. Volume II, Pulp and Paper Manufacture, mentions that 12 to 18% sodium sulphite on the wood will result in yields of 65 to 75%. We use slightly less than this and obtain corresponding yields.

3. Concentration of chemicals: This item is fixed as we know, by the preceding two requirements. With a low liquor to wood ratio it is necessary to use quite concentrated liquors.

4. Liquor composition: In 1949 Keller and McGovern published a study of the effect of buffer on the properties of neutral sulphite semichemical pulp. I interpret this work to indicate that the relative quantity of buffer used has little effect on yield or the properties of the pulp with the exception of fold. If a bright pulp is desired a lower quantity of buffer should be used.

These interpretations have been confirmed by our commercial operation.

5. Cooking temperature: Cooking temperatures are generally high and correspond to steam pressures above 150 lb. gage. In our case we are cooking at 170 lb.

6. Total time: Total cooking times are usually between 4 and 20 min. depending upon the quality of the stock desired and other factors. We have found that the qualities we are interested in change very little with time in a range of 10 to 20 min.

7. Time to temperature: In continuous pulping we can consider that each individual chip is suddenly placed in a large volume of saturated steam. Calculations indicate that the time for a chip $^1/_4$ in. thick to reach equilibrium with the surroundings is something less than 2 min. There is a possibility that the steam might penetrate the fractured chip and increase this time considerably.

8. Penetration time: I have left the discussion of this rather nebulous quantity to the end so that I could present some speculation. None of these remarks are based upon experimental evidence but I believe them to be sound.

Let us look at what happens to the chips as they are fed to the continuous pulper. First the chips are subjected to severe mechanical action in the feed screws. This action is sufficiently severe to squeeze water from the chip. It must also squeeze out part of the air that is trapped in the chip. Then suddenly the mechanical forces are released and the chip is simultaneously sprayed with liquor and subjected to an atmosphere of saturated steam. The chip must return to its original shape due to the releasing of the pressure and the influence of the steam. Any liquor present on its surface is quickly taken into the center of the chip.

This action may be compared to that to which we might subject a sponge. If the sponge is partially filled with water and is squeezed in your hand the water will be forced out along with some of the air. As we release our grip on the sponge it is quite evident that there will be sucking in of any water on the surface.

9. Additional features: In continuous pulping equipment, after the chips are mixed with the liquor they are subjected to a thorough mixing action from the screw that conveys them through the unit. This must result in very uniform treatment of all chips.

Actually we must approach very close to the concept of vapor phase pulping since at no time are the chips submerged for any length of time in liquor.

10. Control factors: I was asked to comment upon the best way to control the reaction. Generally, in controlling pulping reactions we have three variables: time, temperature, and liquor charge, which may be varied to obtain different qualities. In our case both time and temperature are fixed by the production requirements of the mill. This leaves chemical charge.

Whenever the paper mill reports that the stock is very hard to refine the situation can usually be corrected by increasing the flow of chemical into the reaction chamber. This seems to be a simple control procedure but it is effective.

Cooking—Vertical Digesters—Joseph F. Keyes

We use five vertical digesters that were removed from the kraft pulp mill.

The semichemical pulp is made from hardwoods found in this area. It is between 80 and 90% gum. We do not use any oak wood. The wood is chipped on a 10-knife chipper, without being barked. The chipper knives are set at $^{9}/_{16}$ in. and produce large chips. More than 60% is retained on the 1-in. screen of a laboratory test screen. The chips are cooked at 50 lb. steam pressure, using regular kraft cooking liquor. We use 5000 lb. active alkali, as Na_2O, and cooking time is 2 hr. and 30 min. It takes approximately 1 hr. of this time to reach pressure. The charge is blown to a blow tank for further treatment.

Refining—J. E. Sapp

The question of optimum degree of cooking was discussed and the point brought out that insofar as unbleached semichemical pulp for corrugating is concerned there is a range of yields within which the degree of cooking is purely an economic question. Within this range (which in the case of our mill might be about 60 to 80%), a higher yield gives lower wood and chemical costs but higher refining costs and sometimes lower machine production. These factors must all be carefully weighed against one another in order to ascertain the point of maximum profit. Due to different individual circumstances this will probably vary from mill to mill.

The advantages of a two-stage versus one-stage fiberizing system were discussed. The writer prefers a two-stage because: (a) it allows coarse plates to be used for the preliminary disintegration and these give much more life and more satisfactory operation. The final stage can then be accomplished with a finer design plate. (b) A two-stage system gives added insurance against unfiberized chips going from the fiberizing system to the machine.

Various control methods were discussed and it was mentioned that in our mill we use freeness as a routine control method fairly satisfactorily with a regular daily flat screen analysis also for the purpose of checking the average per cent of screened pulp and shives we are getting from the fiberizing system.

Bleaching of Semichemical Pulps—D. J. MacLaurin

There are several distinct kinds of semichemical pulps. The more important ones are those produced using kraft cooling liquors, acid sulphite cooking liquors, and neutral sulphite cooking liquors. The bleaching of semichemical pulps produced with kraft or acid sulphite cooking liquors is not essentially different from the bleaching of low yield pulps from these processes. However, the bleaching of neutral sulphite semichemical pulps is more or less a special case. Because of this, and because of the general and increasing interest in this area of bleaching technology, my remarks on this panel will deal exclusively with the bleaching of neutral sulphite semichemical pulps. General practice on this continent at present is to produce neutral sulphite semichemical pulps from hardwoods. Most of our information about the bleaching of neutral sulphite semichemical pulps is on those made from northern hardwoods. Our experience with southern hardwoods is more limited. Undoubtedly we will need to have considerably more knowledge about the neutral sulphite pulping and bleaching of southern hardwoods because the present and increasing availability of these southern hardwoods makes them a natural source of fibrous raw material.

It is relatively easy to bleach neutral sulphite pulps to just as high brightness levels as are presently obtained for either kraft or sulphite pulps. For brightnesses of about 75 G.E. and higher, a three-stage sequence will probably be required. For intermediate brightness levels, say 65 to 75, a single-stage is probably sufficient. While obtaining typical present-day commercial brightness levels presents no unusual difficulty, neutral sulphite pulps do present a dirt problem. There is a tendency for the bleached pulps to contain colored shives unless the pulp has been very carefully prepared in the cooking stage with attention to good penetration so that the centers of the chips are not overly raw. Also, because of the presence of relatively large amounts of hemicelluloses in neutral sulphite pulps, they are not as easy to dewater as full chemical pulps, and hence tend to require additional washer capacity in interstage washers. This dewatering difficulty can very easily be aggravated if the pulps are in any way beaten or refined during handling prior to, or between, bleaching stages—as for example by excessive pumping or agitation in tanks.

With single-stage hypochlorite bleaching, intermediate brightness levels can be obtained with fairly heavy dosages of hypochlorite. If the pH of such a bleach is controlled at about 8.5 there will be little yield loss. The stability of a brightness developed in this type of bleach is not as good as in multistage sequences. With a single-stage peroxide bleach, intermediate levels of brightness can also be obtained. However, to do this requires what would probably be uneconomic amounts of peroxide. A two-stage hypochlorite sequence does not appear to be particularly advantageous over a single-stage hypochlorite sequence. There are some recent indications that a two-stage sequence involving hypochlorite followed by peroxide will lead to good bleaching results. A typical three-stage sequence involving chlorination, caustic extraction, and hypochlorite or peroxide will produce pulps with brightnesses up to 85 G.E. or even higher. Such a sequence would probably require 15% chlorine in the first stage and $^{1}/_{2}$–1% chemical in the third stage. The use of

peroxide in the third stage appears to improve the pulp color stability.

In the single-stage oxidative type of bleaching, there is neither much yield loss nor change in strength properties as a result of the change in brightness. In the three-stage bleaching sequences, though, there is a significant decrease in yield. This, however, is accompanied by a very significant increase in pulp bursting and tensile strength and a decrease in pulp opacity.

Consider a very generalized statement of the composition of a typical northern hardwood such as aspen. It contains approximately 78% carbohydrates and 19% lignin. A neutral sulphite semichemical pulp of 76% yield from such a wood will contain approximately 65 parts carbohydrates and and 11 parts lignin by weight. A fully bleached pulp from this unbleached pulp at say 60% yield will contain about 59 parts carbohydrates and 1 part lignin by weight. Thus it is apparent nearly all of the lignin has been removed from the wood by the pulping/bleaching sequence and relatively little of the carbohydrates has been removed by the pulping/bleaching sequence. This is distinctly different to other presently used pulping/bleaching sequences for such as kraft or sulphite. In them, a considerably larger portion of the carbohydrates is removed. The fact that a bleached neutral sulphite pulp retains a large proportion of the carbohydrates originally present in the wood and only a small amount of lignin, means not only a good, high yield from the wood, but also that the bleached pulp has certain unique properties. Because relatively small amounts of the wood carbohydrates are removed in the pulping/bleaching sequence, it follows that the bleached pulp contains a significant amount of hemicelluloses. Therefore, bleached neutral sulphite pulps are very easy beating and develop relatively high burst and tensile rapidly. Sheets made from bleached neutral sulphite tend to be stiff and rattly—of the rag bond or glassine type—the very opposite to the bulky, limp, opaque sheet one gets from a soda-type pulp.

In summary then, fully bleached neutral suphite pulps can be produced with a normal three-stage sequence. The unbleached pulp should be carefully prepared when subsequent bleaching is planned

High Yield Pulping

Introductory and General Remarks—J.McK. Limerick (Bathurst Power & Paper Co.)

With wood costs representing such a large portion of the value of pulp and paper, it becomes increasingly important to strive for improved yields from the raw material. As manufacturing costs increase there is no more attractive way to make savings than to improve pulp yield. Since installing the high yield process at Bathurst in 1945, the yield has gradually been improved until at present 3 cords of wood are producing the same quantity of pulp as that derived from 4 cords under the former conventional system.

Not only does an increased yield result in a saving in wood cost but it adds to the production from a given number of digesters and usually lowers the chemical charge per ton of pulp. Another important feature is the conservation of the wood resources of the country.

The attractive features of high yield are obvious. However, the process is not without its problems and these will be covered by the speakers that follow. Experience at Bathurst has demonstrated that uniformity in cooking is probably the most important key to successful high yield pulping. This uniformity in cooking results from complete and uniform penetration of the liquor into the chips. Some mills accomplish this by means of a long, slow rise to pressure whereas others use some form of chip pretreatment which gives a faster penetration of cooking liquor. Whatever the method, the end result of uniformity is most important to the refiner operation which follows. Properly cooked high yield pulps have the appearance of actually being lower in cooking degree than a conventional lower yield grade produced without attention to uniformity and having overcooked and undercooked portions.

The washing of high yield pulps presents special problems. The degree of brown stock refining has a great effect on washing efficiency and one mill is now carrying out most of the high yield refining after the washers. This will be treated in detail by the following speakers. Another subject to be covered later is the handling of high yield pulps through the paper machine refining equipment and on the machine itself. It is rather fundamental that as the lignin content of the pulp increases the unbleached strength decreases and special attention must be paid to subsequent refining.

Reference might be made to the possibility of bleaching high yield pulps. The subject was mentioned briefly in a paper presented on a previous occasion when describing the high yield pulps produced at Bathurst.* It is emphasized that the bleaching portion of the study was a laboratory investigation because the company does not manufacture bleached pulps. However, pulps of 82 brightness were produced at final bleached yields from the wood of over 50%. The strength values were higher than pulps cooked and bleached in the conventional way. It is largely a question of balancing wood costs against the value of the increased quantity of chlorine necessary for bleaching.

After the speakers have completed their presentations on the various aspects of high yield pulping, the real value of this panel will come from the discussion which follows. None of this will be published and all operators will be able to freely discuss their problems.

Washing High Yield Pulps—W. B. Simmons (St. Joe Paper Co.)

At St. Joe Paper Co. we have the conventional setup of controlled consistency stock from the blow tank being pumped through a magnetic separator, a breaker trap, and through two refiners ahead of each line of washers.

We have four lines of three stage Impco 11 ft. 6 in. by 16 ft. valveless washers, each line rated at 350 tons per day capacity, discharging into high density storage tanks.

It has been stated that the more uniform character of high yield hot stock refined pulp makes possible a sheet on the washer which is more easily washed free of residual liquor, that the knotter rejects may be eliminated, and that the rubbing action of the refiner on fiber and fiber bundles increase the strength and felling properties of the pulp. However, they did not state how to get these characteristics.

In order to accomplish this easier washing we initially felt that the following points would have to be controlled:

1. The consistency from the blow tank to be controlled by the motor load of the agitator.

2. As the throughput of the washers is dependent on the header pressure to the refiners, a means of circulating the stock was devised to control this pressure.

3. The Baumé of the first stage liquor would have to be maintained at a level wherein the soda losses from the third stage washer would be a reasonable figure, and the liquor delivered to the evaporators would have a solids content high enough for operations.

On starting up with these controls we found that at times we were producing 400 tons per day over a line of washers while at other times the production dropped to 100 tons or less.

This fact led us to investigate some of the variables which would affect washing and which could be measured and controlled.

Initially we had to determine what could be measured in the

* Limerick, J. McK., *Tappi*, 35, No. 7 (July 1952).

stock which would determine whether the stock would wash at a high production rate or a low rate.

The Canadian Standard freeness tester and the TAPPI Standard SFMC drainage tester were both investigated. As neither of these gave us the desired information we designed our own testing equipment.

This apparatus consists of measuring the volume of water drained through a given weight and area of the refined stock for 20 sec. This we define as the drainage rate.

Upon testing we found the correlation between the throughput of the washers and the drainage rate to be excellent.

As we now had a means of measuring the washability of the stock, the next was to determine what independent variables affected this dependent variable and the magnitude of each.

Investigation showed that it would be possible to measure and control the following variables: (1) consistency, (2) inlet pressure to the refiners, (3) refiner disk loading (ampere reading), (4) Roe chlorine number of the stock, (5) percentage of rejects in the refined stock.

Our initial series of tests were conducted keeping the refiner disk loading constant. The results of these tests showed that the consistency within operating range was the least important variable; however, it was discovered that the higher the consistency the less problem we had with foam, therefore all subsequent tests were conducted with the blow tank consistency being maintained as high as possible.

By the use of statistical techniques we were then able to determine the order of importance of the other independent variables. These were found to be: (1) percentage rejects in refined stock, (2) refiner disk loading, (3) Roe chlorine number, and (4) refiner inlet pressure.

Once these factors became known it was relatively easy to establish a control program.

As some of these factors affect other operations beside pulp washing the following was set up.

1. The percentage of rejects is maintained between maximum and minimum limits. This was done because too high a percentage of rejects causes trouble in the screen room and too low a percentage cuts down on washer capacity.

2. The refiner disk loading must be held as low as possible to prevent over refining and lowering of the drainage rate.

3. The Roe chlorine number is held between prescribed limits. This is imperative as too soft a stock will not wash properly and too hard a stock will not screen properly.

4. The refiner inlet pressure controls the throughput of the washers and is held constant at the desired level.

As to the effectiveness of this program we can state that we are now getting this easier washed sheet.

We might also add that the disk loading on the refiners has been reduced from 120 to 70 amp.

PROPERTIES AND CHARACTERISTICS OF HIGH YIELD PULP AS PRODUCED AT SOUTHERN PAPERBOARD CORPORATION—DAVID WETHERHORN (Southern Paperboard Corp.)

When the decision was made to go to high yield pulping at Southern Paperboard Corporation the research department was asked to develop cooking conditions that would produce a pulp with one important characteristic: The ability to be made into a high quality linerboard at the fastest rate of the machine.

We set up experimental cooking operations with a 1-cu. ft. digester and cooked to yields of 54 to 64%. To get a more complete picture of the effect on yield and pulp properties of the major variables in question the experiments were planned so that the results could be analyzed statistically for significant differences. This project was accomplished with aid of Don Libby of Gair Research Department. A pulp was produced at 60% yield that had strength development characteristics, as shown by beater curves, equal to the normal yield pulps made in the mill.

In order to develop the best control test to use in the mill, all of the pulps were subjected to (1) Roe chlorine, (2) modified Tingle, and (3) permanganate number-using 75 and 100-ml. of permanganate, keeping normalities the same as TAPPI standard T-214 as a determination of the degree of cooking. The 75-ml. permanganate test was selected as the safest and easiest control for mill work. The correlation with yield was poor with all three methods but for degree of cooking was good enough for mill control.

The mill is now producing pulp that runs 48 permanganate no. ±2 from the digesters and gives 52 ± 1 permanganate no. in the regulating box. This gives a 58% board yield, and reports from the converting plants say the over-all quality of the linerboard is better than the normal yield liner.

It has been noticed, with the dry summer wood being received this year, that if the permanganate number in the regulating box gets above 55 more difficulty in drying on the machine is experienced.

Since we do not make bleached board no information can be given on this phase of high yield pulp utilization.

The moderator has requested a description of our method of producing high yield pulp since it differs somewhat from the other mills that have representatives on the panel:

Nine digesters—3320 cu. ft. each are used for cooking. They blow to two blow tanks. From the blow tank the stock goes through a Claflin prebreaker (running at half power load), to vacuum washers. From the washers to a high density storage tank and then to seven Sprout-Waldron 36-2 refiners. Ten IMPCO centrifugal screens are used for primary screening, two for secondary screening, rejects from these go to a Drainalator and then to a Sprout-Waldron rejects refiner. Five deckers are used for thickening and then the stock goes to the paper mill stock chests.

The maximum tonnage to date is 680 tons and the soda loss on the washers runs 30 to 35 lb. salt cake per ton moisture-free pulp. Rejects from the washers run 5 to 10% as determined with a 10-cut plate on a Valley laboratory flat screen. Rejects after the Sprout Waldron refiners run less than 1%. S. R. freeness runs 890 to 900 on the washers, 860 to 870 after the refiners, 845 to 850 for the base sheet on the machine, and 690 to 700 for the top sheet.

HIGH-YIELD PULPS—L. M. SUTHERLAND (Sutherland Refiner Corp.)

Adequate refining of high-yield kraft pulps is dependent on several factors of which the following are the most important:

1. Effective softening of the encrustant bond holding the fibers together.

2. Removal of tramp metal to fullest possible extent prior to refining: (a) from chips prior to cooking, (b) from blow tank, (c) from pulp between blow tank and refining system.

3. Pulp temperature. (Usually 190 to 215°F.)

4. Pulp consistency controlled to suit mill conditions. (a) type of refining equipment utilized, (b) available pumps, (c) effective tramp metal removal.

5. Another important item is determined by the results the individual mill desires to achieve. In other words, the objective of high yield refining may range from maximum defibering with a minimum of hydration to production of a well-hydrated pulp with a minimum of rejects and possibly with the further intention of eliminating the screen room.

Where a reasonable amount of hydration is procured in the hot refining stage of the process, a reduction in power required for refining on the paper machine can be expected with pulps ranging up to about 14 to 15 chlorine number. There is also reasonable expectation of obtaining better bursting strength in the finished product and an over-all lower power consumption than in cases where the pulp is defibered without measurable increase in slowness or felting power of the pulp.

Under the above conditions screen rejects subsequent to high yield kraft refining may range from 1% or less up to 10 or even 15% in commercial operation.

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Other reasons for selecting a given degree of hydration or defibering may arise from questions of washer capacity, type of refining equipment in use, and cooking techniques employed. Such considerations may also dictate refiner operating technique, including setting and power input.

Basically, the refining problem may be illustrated by the following data extracted from reports of the Forest Products Laboratory on pulping of southern pine woods. Complete data are available in TAPPI papers.

Item no.	*Roe Cl_2 no.*	*Total yield*	*Screened yield*	*Rejects, %*
1	4.0	46.0	46.0	0
2	4.3	46.4	46.3	0.1
3	4.6	46.9	46.9	0
4	4.9	47.4	47.1	0.3
5	5.1	46.7	46.7	0
6	5.6	49.1	48.4	0.7
7	8.1	50.6	48.3	2.3
8	6.1[a]	51.8	47.4	4.4
9	10.3	52.7	45.2	7.5
10	13.6	58.3	8.3	50.0

[a] Believe chlorine number printed should be 9.1.

These data are substantiated in commercial practice by the experience of mill operators, namely, that beyond a certain point—usually around 8 to 9 chlorine no.—the per cent of rejects increases so rapidly that operation becomes impractical. As a result, cooking procedures are adjusted to obtain a maximum yield consistent with successful screen room operation and minimum operating problems arising from an excessive quantity of rejects. Common experience in southern kraft mills cooking for liner board without hot stock refining shows a reject load averaging around 7 to 9% screen rejects. Available data indicate that these mills seldom operate at higher than 8 to 9 chlorine no. or say 30 to 32 permanganate no. 40-ml TAPPI.

LOCAL SECTION ACTIVITIES

Reports of Meetings, Personnel, and Events

Ohio

The Miami Valley Superintendents' Association was host at a joint meeting with the Ohio Section of TAPPI on Nov. 16, 1954, in Cincinnati, Ohio.

The afternoon portion of the meeting was dedicated to visits to the Robert A. Taft Sanitary Engineering Center and the Little Miami Sewage Treatment Plant. The Robert A. Taft Sanitary Engineering Center is a research center, sponsored by the U. S. Public Health Service, where research is done on all types of pollution including the effect of pollution on stream characteristics and possible treatment. The Little Miami Sewage Treatment Plant which has just been completed is the first of four proposed treatment plants for the Cincinnati area. It is designed to treat 200 million gallons of sewage per day. Both visits proved to be very informative.

A dinner, which was preceded by a cocktail party, was held in the evening at the Hotel Alms after which time two highly interesting papers were presented.

Dean Newell, Phillip Carey Co., Cincinnati, Ohio, who is chairman of the Miami Valley Superintendents' Association, was the master of ceremonies for the dinner meeting. Mr. Newell introduced the officers of the Superintendents' Association and then called upon Harold Joiner, Champion Paper & Fibre Co., Hamilton, Ohio, who is the chairman of the Ohio Section, to introduce the officers.

Mr. Newell then introduced Hayse Henry Black, chief engineer, Waste Disposal Section, Robert A. Taft Sanitary Engineering Center, who chose "Treatment of Industrial Wastes" as his subject. Mr. Black gave some history on the treatment of waste from paper mills, pointing out that through the years there has been considerable progress made by the paper industry in the prevention of waste. According to Mr. Black, this progress is due mainly to the use of savealls and the recirculation of white water. He feels that, although the paper industry has come a long way, there is still a great deal more work to be done.

Mr. Black then introduced Mr. McDermott, engineer, Industrial Waste Section, Robert A. Taft Sanitary Engineering Center, who discussed "The Effect of Waste on Stream Characteristics." Mr. McDermott outlined the research being done by the Health Service on Lytle Creek which is a small stream near Cincinnati. Correlation between waste load and dissolved oxygen content and its effect upon stream flora, aquatic life, and bacteria content is being studied extensively.

The meeting was a great success, and all those present undoubtedly have a greater appreciation of the effects of stream pollution.

December Meeting

The December meeting of the Ohio Section of TAPPI was held on Dec. 9, 1954, at the Legion Hall in Middletown, Ohio. Although it was a snowy and icy evening, 110 members turned out to hear George Pringle, Mead Corp., Chillicothe, Ohio, who is the National President of TAPPI, discuss "Human Engineering in the Pulp and Paper Industry."

Chairman Harold Joiner, Champion Paper and Fibre Co., Hamilton, Ohio, opened the meeting and welcomed those present, after which Mr. Pringle was introduced by Larry Moore, Black-Clawson Co., Hamilton, Ohio.

All those present found Mr. Pringle's paper very informative, since it dealt with the pressing problem of how to acquire and retain the interest of qualified technical and nontechnical personnel in papermaking as a career.

Mr. Pringle's talk was followed by a report of the Educational Committee of Ohio TAPPI which was presented by John Clouse, Oxford-Miami Paper Co., West Carrollton, Ohio. Mr. Clouse reported that the Educational Committee has outlined a 5-year plan designed to interest high school students in seeking careers in the paper industry. This program is scheduled to begin with the current school year. An outline of the program follows.

Ohio TAPPI Program to Interest Students in Entering the Paper Industry

Purpose. To interest high school students in preparing to enter the paper industry as a field of employment. Special emphasis to be given science students and an effort made to direct interest toward papermaking colleges. However, efforts will also be made to direct student thinking toward papermaking in all its phases and at all training levels.

Plan. A definite method of proved effectiveness is not presently available. Therefore, we have plotted a tentative course which can serve as a guide but which may be changed to meet proved needs as we proceed.

This plan progresses stepwise, on a 5 year basis, toward eventual stability of method and toward active participation by all the mills in the area.

Tentative 5-Year Plan

First Year (Spring, 1955)

1. Contact science teachers by letter and volunteer to present any of the following to their classes:
   (a) Papermaking demonstrations.
   (b) Panel discussions.
   (c) Papermaking films.
   (d) Plant visits.
   (e) Personal interviews.
2. Work through teachers' organizations, conventions, and publications to stimulate interest among educators in the project.

Second Year (1955–56)

This year differs from the first principally in the effort made to reach all high school juniors and seniors. During the second year, we will actively seek places on all school calendars rather than wait for requests from the teachers. We plan to start early

Reading from left to right: Ellsworth Shriver, Program Committee chairman; George Pringle; Harold Joiner; George Gregg, Treasurer, Ohio Section; Larry Moore

in the Fall to reach students before they have selected a college.

At the end of the year, we will evaluate the program and set up a continuing program for future years.

Third Year (1956–57)

1. Approach local industries and seek their aid in forwarding the program in the following ways:
   (a) Scholarships.
   (b) Summer jobs for promising prospects.
2. Secure active cooperation from various paper schools.

Fourth Year (1957–58)

Start Summer job program (noted above).

Fifth Year (1958–59)

Start scholarship program (noted above).

E. W. Petrich, *Recording Secretary*

George Pringle, National TAPPI President, Mead Corp., Chillicothe, Ohio

Larry Moore, Ohio TAPPI Program Committee, The Black-Clawson Co., Hamilton, Ohio

Human Engineering in the Pulp and Paper Industry

G. H. Pringle

It is a real pleasure for me to meet with you tonight and to bring to you greetings from National TAPPI. We, in National TAPPI, are very proud of our various sections as we realize that they are the backbone of our organization. We have been particularly proud of the Ohio Section over the years for the things they have accomplished and I naturally have a real personal interest and pride in this, my own, TAPPI Section.

In my opening talk in New York last February, I covered how our industry had grown in the last 25 years, coming from 18th place nation-wide to 5th place. I also covered the progress made by technical men in our industry during the same period and pointed out that 25 years ago their activities were confined to engineering and technical service, whereas today they are in top positions throughout the organization.

In this talk I covered, in detail, the necessity of increasing enrollment of technical men in our universities and, at the same time, getting these technical graduates into our industry. I pointed out that the pulp and paper industry has as much, if not more, glamor, challenge, and security than any other industry.

I was very pleased to know that you had set up an Educational Committee with John Clouse as chairman. As I understand it, this committee is going to work out a program with reference to the paper industry in this area for presentation to the high school students, pointing out to them the advantages of employment in our industry, and in this way establish interest on the part of these high school students to follow through and obtain university training with the view to establish themselves in the pulp and paper industry. This, in my mind, is certainly a very worth-while project and this committee should receive the full support of all members of the Ohio Section of TAPPI.

In addition to the above points, I believe there is another, and very important one, that must be considered if we technical men are going to hold our present position in the pulp and paper industry, and, I refer, to the human element in our operations which can be referred to as human engineering.

We have in the past been criticized that we give too much thought to new machines and materials at the expense of man, and, I believe, that this criticism has been justified. We have developed new tools, machines, and equipment to improve quality and reduce labor costs but we have given very little, if any, thought to what effect these equipment and material changes will have on the men out in our operations. I can truthfully say that I personally believe that the above has been true of most technical men in our industry. After 26 years' experience in the engineering phase of the pulp and paper industry, I was, a little over 2 years ago, transferred to an operating position and this point was brought home to me very forcibly.

In our industry we are very fortunate that, in most cases, our unions go along on the premise that manufacturing changes are inevitable and desirable. They agree that these changes are the prerogative of management and in most cases do not offer any objection to such changes in our equipment or processes.

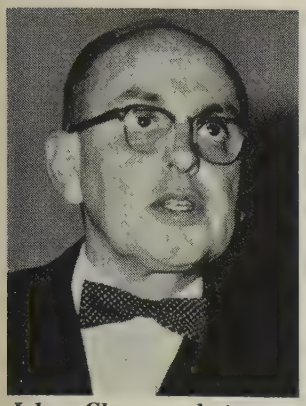
In our initial planning of any new project, such as a new paper machine or a major rebuild of an existing one, we should take into our confidence the operators to obtain their ideas on the equipment as well as the process. Any man who has served as a machine tender, backtender, or even third hand for 25 or 30 years certainly has some very constructive suggestions to offer on any change to be made in our operations. I realize that such types of employees have difficulty in interpreting drawings but by simplification and discussions with these various men, the engineer or technical director can obtain their ideas and in most cases these suggestions are sound and should be incorporated in this initial planning phase of any project.

As the job progresses, the hourly paid employees, as well as the supervisors, in this particular department should be kept informed of these proposed changes. Our employees are very conscious of job security and if they see changes being made which will affect their job they are certainly going to be concerned about them. To illustrate this point, we recently started up a new pulp mill in one of our operations which called for the shutting down of two old pulp mills and the rearrangement of all the jobs in our pulp operation, including the elimination of 17 employees. As soon as the planning of this project was far enough along, the pulp mill supervisors and personnel manager working very closely together, and, with the union organization set up the jobs in this new pulp mill and at the same time worked out, on a seniority basis, new jobs in the organization for the 17 men that would not be required for this new pulp mill operation. As soon as this planning was completed, the employees were notified, which was about 6 months before the new pulp mill actually went into operation.

This point, I think, is very important and this information should be passed down to the employees concerned at the earliest possible date so that they will know how these changes will affect their future in the organization.

In the October, 1954, issue of *Reader's Digest* there is an article entitled "Workers Don't Have to Be Robots." This article, which was written by the chairman of the board of International Business Machines, points out that enlarging rather than narrowing the worker's task stimulates his interest, reduces boredom and fatigue, and boosts productivity. To illustrate this point, this article uses as an example a woman operator on a milling machine. This machine was

G. H. Pringle, The Mead Corp., Chillicothe, Ohio.



John Clouse, chairman, Ohio TAPPI Educational Committee, Oxford-Miami Paper Co., West Carrollton, Ohio

Harold Joiner, chairman, Ohio Section, TAPPI, Champion Paper & Fibre Co., Hamilton, Ohio

set up to cut slots in small pieces of steel. There was a man who set up this work for this woman operator and at the completion an inspector who checked it. The only task performed by the operator herself was starting and stopping the machine. International Business Machines trained this woman operator to set up her own work, as well as inspect it, and in this way eliminated two jobs. This job enlargement, as covered by the above illustration, has brought about a number of by-products at the large IBM plant at Endicott. Employee suggestions have trippled; absenteeism is down. Scrapped parts, which used to cost the company $1.90 for every $100 worth, now cost only 96 cents. Moreover, the impact of enlarged jobs of monotony may have some connection with the fact that this plant holds the world's safety record in the light machining industry: 12,770,257 man-hr. without one lost-time accident.

I wanted to use this illustration to point out that we should give each employee the opportunity to do what he is capable of doing. We will then bring out the best in him, heighten his interest, and make him more valuable to the company.

I believe that all of us have in our organization some old time operators. I am thinking particularly of machine tenders who have the "know-how" of making a good sheet of paper, but these men are not very well educated and it is practically impossible for them to put down their thoughts in writing. These men, due to retirement or death, will not be with us many more years and before they leave our employee we should certainly take the necessary steps to get their "know-how" of papermaking down in writing. This is very necessary for the training of younger men coming up in our organizations and even for young technical men starting in our operations.

On several occasions members of TAPPI have approached me with reference to the Technical Association obtaining this information on practical papermaking and bringing out a publication covering it. This would probably be a worthwhile project for TAPPI but on the other hand I don't believe it could be handled successfully in this manner. There are too many detailed procedures that are applicable to only one mill and a number of cases to only one machine and for this reason, I believe the only successful way to handle this is by individual mills obtaining these data on their own.

A good approach to this problem is to select a good practical tour foreman, or a machine tender with the equivalent of a high school education, and have him work with these machine tenders and put down on paper the various procedures followed by these older employees to correct any deficiencies that may occur in their operations. This means that for each grade of paper manufactured certain adjustments are necessary to meet quality specifications and these adjustments are all marked down on paper by the machine tender, or tour foreman.

In some cases, these older machine tenders with this "know-how" may not agree on one or several points. When this disagreement occurs, a trial should be made using the procedure recommended by the several older employees involved, and, in this way the best procedure will be set up. As an illustration of this point, in some of our work, three machine tenders would not agree on the best type of cleaner to be used for washing a felt. All three cleaners were used on a trial basis and in this way the most satisfactory one was set up.

The procedure outlined above for obtaining the "know-how" of these old time employees will take considerable time and, of course, numerous revisions will be required. I believe, however, that getting this information down on paper is very important and certainly will mean a great deal to our operations when these old time papermakers are no longer available.

There is another point that I would like to mention as I believe it is an important one and that is communications, both up and down the line of organization. Any loyal employee, even though he is a laborer in the woodyard, is interested in what is going on in his company and what its plans are and how they will affect his future. This covers company earnings, order situation, equipment or process changes, retirement plans, etc. We should also have an avenue for the thinking of these employees to come on up the ladder to management.

I do not like to advocate a large number of meetings as they are time consuming and in a lot of cases the results are questionable. In this matter of communications, however, I believe that the mill manager should have a policy or staff meeting of his department heads once every 2 weeks, or even once a month. In this meeting the various department heads will have an opportunity to express their views and the manager should pass on to these department heads as much information as he can with reference to the operation of the mill and any other details pertaining to the company that are of interest. Minutes should be kept of this manager's meeting and, following it, each department head should have a similar meeting with his supervisors or foremen and reference made to the minutes of the manager's meeting. The same procedure should follow down the line until the entire organization is covered.

We have found that this procedure is the best method of communications between top management and the employees, as well as from the employees up to top management.

Another tool which we have found beneficial along this line of communications is a daily single-page publication which is put on the notice boards in the mill not later than 10 o'clock each morning. In this publication credit is given for any outstanding operation the previous day because all of us like "a pat on the back" when we do a good job. This also gives us an opportunity of telling the employees of any plant visitors that will be out in the mill that day, who they are, and where they are from. It also is an avenue for the employees to advertise for sale any personal items that they may have. We have found that such a single-page publication is very advantageous, and contrary to our initial thinking, we do not have any trouble in getting sufficient information on a daily basis to fill it up. This is, of course, in addition to the plant magazine which is published on a monthly basis.

Another example to illustrate the results that can be obtained by taking the employees out in the mill into your confidence and giving them *all* the facts—one of our larger customers recently had to reject some paper manufactured by one of our competitors and they were in urgent need of replacement tonnage which they asked us to manufacture for them. Due to our paper machine schedules, it was necessary to make this order on a machine that had never previously manufac-

Executive Committee meeting of the Pacific Section

Norval Magnusson, moderator, and program panel

tured this grade. We gave the entire story to all the employees involved, including the men in the beater room and finishing room, as well as on the machine. We told them that this competitive paper had been rejected and it was necessary for them to make an outstanding sheet on this machine even though they had had no previous experience in the manufacture of this grade. As a result, the entire group of employees involved did their utmost and we did not have any difficulty in manufacturing this order and the quality was equal to, if not better than what we had been manufacturing on our other machine. I do not believe that we would have obtained these results if we had not taken the entire group involved into our confidence.

I believe one of the most important things that we older technical men in the industry must do is to impress upon the younger men entering our employ to get on the good side of the old time operators in our organizations. These technical men initially should assume a humble attitude and admiration for these old time papermakers with years of experience behind them. If this attitude is taken these older employees will do everything they possibly can to help train these young technical men.

To illustrate this point, in one of our larger mills our general superintendent graduated from the University of Minnesota in 1947 in mechanical engineering. He went through a training program in this mill, working in every operating department. About 2 years ago he was made paper mill superintendent and last January advanced to general superintendent. We now have as paper mill superintendent and assistant paper mill superintendent two old time papermakers up in their 60's and approaching retirement. The main desire of both these old time papermakers is to teach this young general superintendent everything they know about papermaking and handling men before they reach retirement. As a result of this attitude, this young mechanical engineer is doing an outstanding job for us and will continue to because he has learned how to win the confidence of the old time practical man who is so very valuable to all our operations.

I have endeavored to point out to you tonight the importance of this matter of human engineering to the technical men in our industry. *People* have a very definite place in our planning and will have a larger place in the future. If we are to continue to maintain our position in the pulp and paper industry, we are going to have to give more and more thought to this human element in our various operations.

Some of the thoughts which I have presented tonight originated in our mills at Chillicothe, Kingsport, and Escanaba, and I want to give credit to the managements of these three mills for them.

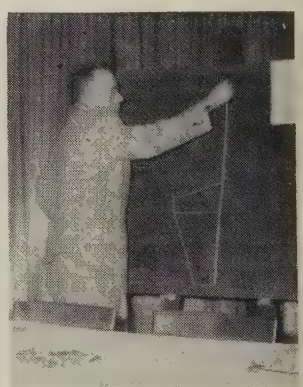
Pacific

The Pacific Section of TAPPI met at Bellingham, Wash., on Nov. 9, 1954, with an attendance of 107. Norval Magnusson, technical director of Puget Sound Pulp & Timber Co., had charge of this meeting and the program centered around the subject of instrumentation.

The technical meeting was held at 2:00 p.m. at the Leopold Hotel and Mr. Magnusson acted as moderator for this meeting. The first paper presented was entitled, "Sulphur Dioxide—Ammonia-Water System" by Dan Hayden, graduate student, University of Washington. The second paper was

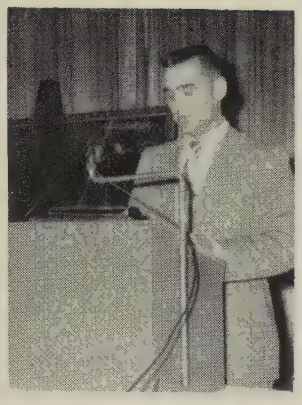
Erik Ekholm, Puget Sound Pulp & Timber Co., introducing Curtis Cortelyou, General Petroleum Corp.

Dan Hayden, University of Washington and Norval Magnusson

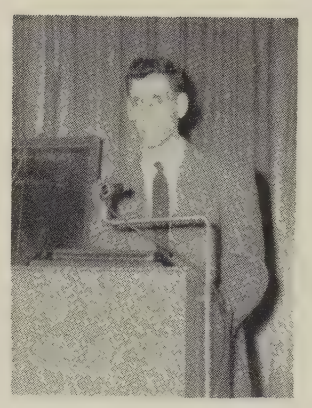


Arthur Damman, Ketchikan Pulp Co.

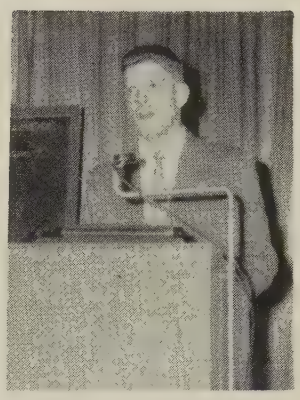
James Wenger, Crown Zellerbach Corp.



Vance Reynolds, Puget Sound Pulp & Timber Co.



Dewey Hewston, Puget Sound Pulp & Timber Co.



Jack Dunkak, Puget Sound Pulp & Timber Co.

entitled "Instrumentation of Ketchikan Pulp Co." and was presented by Arthur Damman, instrumentation engineer at Ketchikan Pulp Co. Mr. Damman discussed the basic design, the costs, type of instrumentation, and air system used at his mill. He described specific installations and gave a detailed description of their acid plant system.

Following these two papers, the subject "Control Valves for Handling Slush Pulp Stock" was discussed by a panel consisting of the following: James Wenger, Crown Zellerbach Corp.; Jack Dunkak, Vance Reynolds, and Dewey Hewston, all of the Puget Sound Pulp & Timber Co. Following this panel presentation, the meeting was thrown open to a general questions and answers period. The meeting was adjourned at approximately 5:00 p.m. by Mr. Magnusson.

Following the technical meeting the group met for a social hour and dinner. Curtis Cortelyou, manager, Ferndale Refinery, General Petroleum Corp., Fern Dale, Wash., spoke.

H. B. PETERSEN, *Secretary-Treasurer*

Southeastern

The Southeastern Section of TAPPI met at the King and Prince Hotel, St. Simons, Ga., on Nov. 12, 1954. One hundred twenty members and guests registered.

An Executive Committee meeting was held at 4 p.m. at which future programs for the year were discussed. The next meeting is scheduled for the Francis Marion Hotel, Charleston, S. C., on Jan. 14–15, 1955.

Registration was at 6 p.m. The social hour was at 6:30, followed by dinner at 7:15.

The general session began at 8 o'clock with Mr. Pineo, section chairman, presiding.

A. H. Owens, personnel manager, Brunswick Pulp & Paper Co., gave a very interesting and entertaining talk in his speech of welcome on behalf of the host mill.

Mr. Pineo turned the meeting over to Mr. Chapman, program chairman, who presented the speakers.

T. T. Collins, Jr., technical director, National Container Corp., Jacksonville, Fla., presented a paper on "The Oxidation of Sulphate Black Liquor and Related Problems." Tex has been active in the field of black liquor oxidation for several years and is well qualified to speak on the subject. This article included a review of work of various groups of investigators of this problem, as well as recent literature and patents covering the subject. A description is given of the author's developments for the so-called "fume-heat-sulphur recovery process," consisting of the Venturi-scrubber now operating on black liquor at Thilmany Pulp & Paper Co., and various black liquor oxidation systems. A comparison is made of the foaminess of black liquor from various sources. A calculation of the lime saving effected by the raise in sulphidity due to oxidation is also made. It is predicted that the third major step in reducing sulphur losses from the recovery system will be the design and proper operation of the furnace to cause it to generate sulphur dioxide rather than hydrogen sulphide.

An interesting paper on "Wire and Felt Performance Records" was given by J. M. Mallory, chemical engineer, Union Bag & Paper Corp.

Mr. Mallory's discussion of the data, record keeping, and study of this phase of operation indicates the thoroughness with which this problem was attacked. The text of the paper is submitted below.

G. M. Dickinson, Sonoco Products Co., Hartsville, S. C., discussed their experimental work and pilot plant digester in his paper "Some Problems Relating to Digester Yields."

A. H. Owens, Brunswick Pulp & Paper Co.

T. T. Collins, National Container Corp.

H. F. Lewis, The Institute of Paper Chemistry; W. C. Chapman, Union Bag & Paper Corp.; M. B. Pineo and A. H. Owens, Brunswick Pulp & Paper Co.; and R. G. Macdonald, TAPPI

Harry F. Lewis, dean, The Institute of Paper Chemistry, Appleton, Wis., was the principal speaker of the evening. An outline of his very interesting discussion on five areas of research necessary to meet demands of future production is presented.

Mention was made of the recent predictions on the increase in pulp, paper, and board requirements during the next 25 years. Latest figures suggest that these would considerably more than double current production by 1979.

To meet these figures it was suggested that consideration needed to be directed in at least five fields, as follows:

1. *Improved trees*—and this involves an expanded program in genetics along the lines of selection of superior trees (now being practiced in Europe to some extent and to some degree in the United States), through induction of mutations as by radiation, etc., through hybridization (hybrid poplars), and by polyploid production. This latter direction particularly is being followed by Mr. Joranson and his group at The Institute of Paper Chemistry.

2. *More basic knowledge on growth and fiber production.* Here it was pointed out that much work is being done on photosynthesis but almost none is being carried out on the reactions in the cambium. This is of particular interest as part of the lignin problem. As one approach, the work of Roland Kremers and collaborators at the Institute was cited.

3. *Improved forest management.* TAPPI Monograph 4 published in 1947 pointed up some of the problems in this field. Not so much research but the application of what is known is being used to good advantage by some companies. This is probably the point of immediate attack on the matter of providing an ample number of trees in 1979.

4. *Research in pulping directed toward the improvement in yield and quality and the use of so-called "useless species."* It is currently in progress; much of this might better be classified as development work. Basic research needs to be expanded until there is an understanding of the fine structure of fibers, the location in wood of its broad chemical constitutents, a knowledge of the molecular structure of the components and their relation to each other, and of the physical and organic chemistry of the pulping and bleaching process. From this and in conjunction with present studies, it should be possible to increase the yield of pulp without any loss in pulp characteristics.

5. *Man power.* One of the most vulnerable points in this program directed toward the production needs of 1979 is that of technical man power. Teachers colleges report a dearth of students preparing to teach chemistry and physics in the high schools. Deans and heads of college chemistry and physics departments are reporting small classes, with the possible exception of the current freshman class which in some schools seems to contain more science-minded students. Graduate schools feel the shortage of good graduate material. Engineering schools, by a vigorous program, may possibly have stopped the decline in engineering enrollment. Draft boards and war man power practice are having their effect. Today, we are behind Russia in the training of engineers and scientists. Improvement of this condition should be made the business of the members of TAPPI and their organizations. Support should be given those institutions needing particular help, and this applies especially to the liberal art colleges which have produced so many of our scientists in the past and which today find themselves in desperate financial conditions because of the inadequacy of their resources. Students in high school who have leanings toward science and technology should be encouraged to go to college, university, or technical school. Good teachers should be assisted in order to stop the migration of teachers to industry.

All in all, meeting the 1979 target of production will take planning and immediate action.

Mr. Chapman turned the meeting back to the chairman, Mr. Pineo, who introduced R. G. Macdonald of National TAPPI, who is always welcome in our Section. After a few brief remarks by Mr. Macdonald, the meeting was adjourned.

Brunswick Pulp & Paper Co. mill was open for mill tours Saturday morning.

C. L. Smith, *Recording Secretary*

Wire and Wet Felt Performance Records

J. M. Mallory

Several years ago a separate process engineering group was established at Union Bag known as the water removal group. Its functions were to study some of the factors affecting water removal and drying on the paper machines, including such things as wire, felt, drier felt, flatbox, and vacuum pump performance and machine room ventilation. At that time our wire and felt costs were high and immediate attention was given to the reduction of these costs. This paper will describe the records which are now being kept on wires and felts and some of the effects of this study on our wire and felt performance.

Our wet felt study was started in a manner similar to that used at other companies. A sample strip was cut across the width of each felt removed from the machines and tensile tests run at 1-ft. intervals. We now run a conditioned strip through a Tracerlab beta gage which gives wear patterns with much less effort. This work is done to locate uneven wear caused by such things as improper press loading, inadequate roll maintenance, and bad felt conditioner shoes. Instead of finding a great deal of room for improvement we have found that our press maintenance was good and that little could be done to improve felt life by reducing uneven wear. We still continue these tests, however, as occasionally some uneven patterns are detected, and the causes are investigated.

Along with the wear pattern information, we maintain records of average machine speed, basis weight, nip pressures, and actual running time. One of the machines has kilowatt-hour meters on both presses for measuring the energy input. Another machine is equipped with weir boxes to measure the amount of water collected by the saveall pans under the presses. The weir box flows are helpful in studying the performance of new styles of felts and for comparing the water removal capacity of different makes of felts.

Every 3 months a detailed report is prepared in which all aspects of the felts are discussed. An attempt is made to interpret changes in felt wear with regard to changes in the machine operating conditions. Sometimes this can be done but many times no correlation can be found. In this report felt costs are compared on a basis of total cost per ton of production during the life of the felts.

The total costs include the direct cost of the felts as well as the cost of changing the felts, which reflects the effect of longer life and fewer felt changes per period of time. In this way mill supervision is given a review of all changes which have taken place in the performance of different makes of felts, different felt positions, and changes in the styles and construction of the felts. This information then serves as a guide when felts are ordered for subsequent quarters. In this way, the efforts of the paper mill operators, their supervision, and various service departments are all combined in an attempt to improve our felt life and costs. The performance of each supplier's felts is discussed with the respective salesman when he visits the plant. Since this program was inaugurated, our wet felt costs per ton have been reduced substantially.

For our wire study we maintain records of machine speed, basis weight, and couch vacuum. On two machines the energy input to the couch is measured, as this figure is believed to be related to the energy absorbed in the wire in wearing out

J. M. Mallory, Union Bag & Paper Corp., Savannah, Ga.

J. M. Mallory, Union Bag & Paper Corp.

G. M. Dickinson, Sonoco Products Co.

the wire. One machine has a counter on the couch roll so that the actual miles traveled can be determined.

When a wire is removed from the machine a sample strip is cut out and sent to the water removal group. It is then carefully examined for evidence of excessive or uneven wear. Dirty wires usually indicate that the Broughton wire cleaning showers are not operating properly or that some of the other wire showers or shower strainers need cleaning. The amount of wear on the wire is measured by cutting out individual warp strands at intervals across the wire and measuring the actual caliper loss of these strands. Also a beta gage profile is run on each wire but as yet no significant wear patterns have been found by this means.

We recently calculated the theoretical mass variations which could occur in the mass of a new wire, within the manufacturer's tolerance limits, and found them greater than the mass variations which existed in our worn wires. Several suppliers were asked to send sample strips across the width of wires being manufactured for our mill. Many of these samples have been received and studied and the mass variation in the new wires has been found to be greater than that in the worn wires. The lack of uniformity in some of the new wire samples has been very great and these unexpected variations will soon be discussed with the respective suppliers.

After all the measurements have been made on a worn wire, the caliper loss and metal loss per day, per mile, per ton, and per kilowatt-hour of energy absorbed are calculated., These data for the different makes of wires and different machines are then compared. Whenever an unusual value is obtained an attempt is made to determine the cause.

One factor in wire wear which we have not yet been able to measure successfully has been wire tension. A Downingtown load cell system was installed at one time but considerable difficulty was experienced with excessive stretch of the wire and the equipment had to be removed. We are now considering the use of a high-speed electronic counter for measuring the relative wire tension at different points on the wire travel. We are also setting up a system for measuring the amount of wire slippage on the couch roll by means of tachometer generators on the lumpbreaker roll and couch roll.

Reports on wires, similar to those prepared on wet felts, are prepared each quarter. The different wire data are discussed with the wire company representatives during their visits to the mill. The results of our wire studies have not been as spectacular as with our wet felts, but improvement is being made in wire life and costs each year. One of the greatest benefits has been to interest some of the suppliers in learning more about the details of how a wire actually runs.

Our drier felt study is relatively new and considerable room for improvement exists in life and costs. Worn drier felts are not tested at the present time, but some data are compiled and a report on drier felt performance is issued every 6 months. One feature of this report is a section on damaged drier felts, or rather, the felts which have been taken off the machines for reasons other than being worn out. The number of damaged felts, the types of damage, and the estimated cost of this damage are pointed out; it is believed that as a result of this, paper mill personnel are more conscious of felt damage and make greater efforts to reduce the damage. A similar section on damaged clothing is now incorporated into the wire and wet felt reports.

One of the greatest benefits of our program is the fact that nearly all of the machine clothing suppliers now appear to be more interested in developing better clothing. If we can help the suppliers by running experimental clothing in our mill and giving a thorough and impartial report on the performance of this clothing, we believe that not only Union Bag but the paper industry as a whole will benefit in better machine clothing and lower clothing costs.

Some Problems Relating to Digester Yields

G. M. Dickinson

IDEALLY the problem of computing digester yields may be reduced to two parts: (1) estimation of the total oven-dry content of the raw charge, and (2) estimation of the total oven-dry fiber component of the cooked chips.

The magnitude of the problem is directly related to the scale of the operation: small operations being quite simple and very precise. Plant-scale operations, however, involve the rather common problem of estimating a large population from comparatively small samples. Pulp plants which are equipped to weigh their raw charge are fortunate, since the yield determination is simplified, and uniformity of the pulp is a step nearer.

The data, which we present at this time, were obtained during the course of experimental work, using a 4-ft., stainless clad, rotary globe digester. In this work the raw chips were obtained from the hoppers feeding the production digesters. Our loading scheme permitted us to weigh these chips as they were fed into the small digester. Thus, the real problem at this point was a sampling problem: how many and how large should the samples be in order that the oven-dry content might be reasonably well established?

It had been our custom for some time to take four samples for moisture. We shall show, however, that these samples were too small, and too few.

In order that one might better understand our procedure, it might be well at this point to state that, although our pulping equipment is of pilot plant scale, we have no means at present of processing the pulp other than laboratory equipment. This accounts, in part at least, for our difficulties.

In recent experiments we have included in all cooks a laundry bag of coarse weave containing a weighed quantity of raw chips with a very accurate moisture assay. Wherever this has been done, the cooked chips from the bag and the cooked chips from without the bag are processed separately and two yield determinations made. These parallel yields will be shown later.

Although not directly concerned with the bulking value of our raw chips, since our chips are weighed into the small digester, this is a very real problem confronting any future

G. M. DICKINSON, Sonoco Products Co., Hartsville, S. C.

Table I. Bulking Value of Chips as Affected by Size of Container

	Moisture, %	Volume of container, lb. 1 cu. ft.	4 cu. ft.	8 cu. ft.	32.5 cu. ft.
Net weight green chips	51.6	22.0	87.5	174.0	638
Oven-dry wood per cu. ft.	...	10.7	10.6	10.53	9.50
Net weight green chips	48.7	21.3	81.0	174.0	631
Oven-dry wood per cu. ft.	...	10.9	10.4	11.16	9.96
Net weight green chips	47.4	20.9	83.7	164.2	645
Oven-dry wood per cu. ft.	...	11.0	11.0	10.76	10.40

yield determinations on the production digesters. As a matter of interest, Table I gives a series of three experiments designed to show the bulking value of raw chips as affected by the size of the container.

These data suggest that for comparatively small volumes, the larger containers will accommodate less oven-dry wood per unit of volume. Moderate shaking affects the values very much, and this is, quite likely, a part of the explanation.

Let us turn now to some of the variables with which we are more directly concerned.

At the end of the cooking cycle the black liquor is blown from the digester. Fiber losses are prevented by means of a fine-mesh stainless steel wire which covers the blow line outlet. The cooked chips are then dumped into a leachcaster and allowed to drain. Since these chips are also weighed manually, it is necessary to wait some 24 hr. until they are sufficiently cool. Samples of the hot chips when freshly dumped are weighed and reduced in a 12-in. disk refiner. The pulp so produced is caught in a fine mesh cloth bag, and this pulp is then made up into a beater furnish with both pulp and water carefully weighed. During the beating process samples for consistency are taken in quadruplicate. These determinations serve to establish the amount of usable solids in the cooked chips. It is necessary to take two sets of samples from the cooked chips: one set when they are hot and freshly dumped and the second set 24 hr. later, so that compensation for moisture loss can be made on the final batch weight.

With this résumé of the process in mind, let us now go back and examine the sources of error.

The average solid content of the raw chips being the first important quantity to ascertain, we elected to draw 21 samples from one loading. The variability of these samples would serve to indicate the precision necessary in the sampling.

The analysis showed that the average dry content (for this loading) was 57.56% and the standard deviation was 1.81. From these data it is possible to schedule a table showing both precision desired and confidence limits.

Table II. Number of Samples, *n* Required to Meet Stated Precision and Confidence Limits

If the precision desired is →	*1%*	*2%*	*3%*	*5%*
When 90% confidence limits are desired	$n = 28$	$n = 9$	$n = 5$	$n = 4$
When 95% confidence limits are desired	$n = 38$	$n = 12$	$n = 7$	$n = 5$
When 99% confidence limits are desired	$n = 64$	$n = 20$	$n = 11$	$n = 7$

This table shows that our sampling was inadequate, and that it would be necessary either to take more samples or to increase the size of our samples. With precision arbitrarily set at 2% and confidence limits at 95%, we would, in this case (which is really a test case), be compelled to take 12 100-gram samples or six 200-gram samples.

Although the cooked chips are somewhat more homogeneous in moisture and solid contents, the sampling must be done with care. This was due, primarily, to an unanticipated stratification of moisture. In order to reduce evaporation of moisture to a minimum, it had become our custom to cover the leachcaster with a felt and leave for 24 hr. as indicated above. This resulted in condensation of moisture at the top. The stratification is clearly shown in Table III.

Table III. Variation Within Leachcaster of Solid Content in Cooked Chips

Top samples, %	*Middle samples, %*	*Bottom samples, %*	
47.2	48.4	49.5	
48.1	48.4	50.9	
47.3	48.6	48.7	
49.1	48.6	50.8	
Average, % 47.9	48.5	50.0	
Average all 12 samples, %			48.80
Average 20 samples when dumped, %			46.50

Clearly, the question of securing representative samples from the cooked chips is not difficult, and a very few samples will suffice to give the necessary accuracy.

The next sampling technique examined was the beater consistency. The quadruplicate sampling was shown to have an error which would seldom exceed 1.5%. Increasing the size of our samples should decrease this error to approximately 1.0%. Apparently, no further refinement in this technique is indicated.

In our limited experience with the bag yield technique, we found that the bag yields consistently ran higher than the digester yields. A few comparisons are shown in Table IV.

Table IV. Comparison of Digester and Bag Yields

Cook number	*Digester yield, %*	*Bag yield, %*
48	73.9	...
49	74.6	...
50	76.5	80.9
52	76.5	75.9
53	64.4(?)	74.6
54	69.3	70.2
55	75.5	80.0

Since the bag contents are more thoroughly sampled than the digester contents, we believe that the former more nearly reflects the true percentage yield than does the latter. In fact, the processed pulp from the bag represents a very high percentage of the total contents.

SUMMARY

Our study of some of the variables contributing to errors in digester yield determinations has led to the following conclusions:

1. For a scale of operation such as ours, the number of samples of raw chips should not be less than 12 100-gram samples.
2. The bulking value of chips seems to be dependent upon the size of container used. More work along this line is indicated.
3. The bag method for determining percentage yield is convenient and is believed to be comparatively accurate.
4. Application of a few elementary statistical methods indicates that considerable improvement in the accuracy of our yield values can be effected.

The author wishes to acknowledge the very valuable assistance of J. E. Copenhaver, J. D. Robertson, and M. B. Cunningham, in the planning and carrying out of these experiments.

Kalamazoo Valley

More than 100 paper mill men heard three expert discussions of the qualities which make paper strong at the Nov. 4, 1954, meeting of the Kalamazoo Valley Section, Technical Association of the Pulp and Paper Industry.

James A. Dean, Michigan Paper Co., section chairman, presided at the meeting which was at the Hotel Harris.

Harris O. Ware, sales supervisor of paper chemicals for Hercules Power Co.'s Paper Makers' Chemical Dept., gave the first discussion on "The Basic Skeleton of Paper." He reviewed the mechanics involved in hydrogen bonding of paper. He pointed out the unusual strength which can be contributed to paper through formation of a multiplicity of hydrogen bonds.

The speaker showed many unusual and interesting slides, emphasizing the characteristics of the cellulose molecule and relationship between cellulose and noncellulose portions of the

Seated: J. A. Dean, chairman of Kalamazoo Valley Section. Standing (l. to r.): Frank Kaulakis, Robt. T. Elias, and Harris O. Ware

papermaking fiber. Included were electron microscope views of fibers, magnified as much as 20,000 times. These clearly showed some basic features of fiber makeup not distinguishable by light microscopic examinations.

Ware's talk accomplished the difficult task of summarizing the present opinions of world paper chemists on cellulose and fiber relationships. He also pointed out that other chemical and physical relationships such as dimension, degree of polymerization, mechanical entanglement, etc., also affect paper strength to an unknown, but lesser, degree than hydrogen bonding.

Robert T. Elias, associate professor in the Paper Technology Dept., Western Michigan College, presented the historical development and various theories of fiber bonding mechanisms to show how progress had been logically pointed to our present theories. Of particular interest to the group was Elias's coverage of the transition from the "hydration" theory to hydrogen bonding.

Mr. Elias's remarks follow:

"The strength standards of any one particular grade of paper are, as you all know, determined by its use requirement. Since there are so many different types of paper, it would probably be best to confine my remarks to fine book papers which are the predominant type manufactured here in the Kalamazoo Valley.

"Among the properties which a printer wants in the paper he buys are sufficient strength to withstand splitting on printing and enough fold endurance to make the printed specimen serviceable. He also wants the paper surface to be free of fuzz.

"The papermaker can build these properties into the paper through the proper selection of pulps and then refine these pulps so as to develop the required strength.

"Unfortunately, when sufficient strength is developed through mechanical hydration to satisfy the printer's requirements, the paper is often cracky and tinny. It may have poor dimensional stability, may develop cockles, and may have a pronounced tendency to curl. The paper may also lack the compressibility which the printer needs in order to turn out a quality printing job.

"On the other hand, underbeaten pulp results in a fuzzy sheet which is down in burst and fold. This paper, however, may very likely have excellent dimensional stability, freedom from curl, and ample compressibility. The close relationship between adequate burst and fold on the one hand and dimensional stability, freedom from cockles and curl on the other can be altered to varying degrees by the use of hydrophilic bonding agents.

"There are a number of high molecular colloids which are or have been used as fiber bonding agents. These materials may be divided into four general groups: starches, proteins, vegetable gums, and water-soluble cellulose derivatives.

"While chemical hydration, which can be obtained through the use of the above additives, is generally considered a beater, headbox, or fan pump proposition, I am also going to include the possibilities of strengthening paper through the use of a size press.

"In general, when one of the bonding agents is added to the beater or the wet end of the paper machine, it should be done with the idea of supplementing rather than supplanting mechanical hydration. Wet end addition of these colloids may also have an effect on formation, filler retention, and freeness of the stock.

"Of the various hydrophilic agents used as fiber bonding agents, the volume of starch used greatly overshadows all the others combined. Of the others locust bean gum, has to date at least, ranked next in importance as regards to amount consumed by the paper industry.

"Native or common starch can be added dry to the beater without being cooked. The temperatures of the paper machine can driers must be sufficiently high (165 to 195°F.) to gelatinize the starch. If the starch is not gelatinized, it will have as much effect on the strength of the paper as an inert filler. This method of using starch is not too common in the book paper industry, but is used in many board mills.

"Oxidized or chlorinated starches are also sometimes added without cooking. This type of starch has a slightly lower gelatinization temperature than raw or common starch which results in somewhat easier pasting during the drying of the paper.

Dry pregelatinized starches are undoubtedly used in greater volume, at least by the book paper mills, than the above starches. These starches absorb water when added to the beater. This partial pasting and swelling aids in retention of the starch. On the whole these starches contribute a greater degree of chemical hydration due to a greater degree of dispersion than that which can be obtained through the addition of uncooked starch. In general, however, pregelatinized starches are used in mills which do not have ample tanks for cooking or where starch is added only intermittently when a point or two in burst is required. It may be well too, to point out that all pregelatinized starches are not alike.

"The use of cooked starch as a source of a chemical hydration, appears to be more logical than the use of uncooked or partially cooked starches. The greater degree of colloidal dispersion of cooked starch results in more efficient absorption on the fiber thus resulting in improved fiber bonding. In order to improve the retention of highly dispersed starch, some mills have adopted the Rowland process of pasting the starch with an alkali and then precipitating this alkaline starch on the fiber with alum. Since the gelatinous alumina starch floc can be easily knocked off the fiber, it is recommended that the starch be added after the jordan. The fan pump is the preferred point of addition. Starch may also be cooked with borax, soap, or other adjuncts which form a complex with starch that will be precipitated by alum. Starches which are flocced with alum will have a greater effect on slowness than starch cooked or pasted without adjuncts.

"It is hazardous to predict how much improvement in burst or fold can be expected for each 1% of starch added per ton of pulp. Under carefully controlled conditions in the laboratory, an increase of 3 points in burst (bursting strength/basis weight × 100) can easily be obtained whereas under conditions prevailing at a paper machine, the effectiveness is reduced to varying degrees depending upon such factors as amount of hydration, machine speed, etc. In furnishes containing mineral fillers, the per cent retention of the filler may be improved by as much as 100%. This is particularly true with starches which are flocced by reaction with alum. It is important to remember that an increase in ash will hide or minimize any improvement in burst or fold which might have been realized from the addition of the starch. The ash

content should be held at a constant level in order to determine the true worth of starch or any other colloid as a source of chemical hydration.

"The freeness of the stock is adversely affected by the increased filler retention. However, if the ash content is held constant, starch up to 3% on the weight of the fiber will usually contribute only a very slight amount of slowness to book paper stocks.

"Of the other water-soluble colloids, locust bean gum ranks next to starch in the volume consumed. Whereas the normal amount of starch added per ton of pulp falls between 1 and 3%, locust bean gum is added at levels between 0.25 and 0.75% on the weight of the fiber. As with starch, variable results in strength improvement are obtained with the use of this gum in actual mill operations. In laboratory comparisons, 0.75% gum on the fiber has shown some 24 points increase in burst as against 18 points increase with 3% starch. In the same comparisons the slowness increase of the stock was 7 sec. with starch as against 33 sec. with the locust bean gum. It is claimed that locust bean gum will improve the formation particularly that of a furnish which consists largely of long fibers. This same claim is made with other colloids. However, starch has little effect on formation. The per cent filler retention is lowered with the use of locust bean gum.

"I am going to just mention the water-soluble cellulose derivatives, guar and protein, as sources of chemical hydration. I have not had any first-hand experience with them and so know very little of their value as bonding agents. A hasty search of the literature shows that these materials can be used to improve the physical strength of paper and are so used although apparently in rather limited quantities. It is interesting to note that methylcellose will improve tear, others won't. With guar again being grown in this country, there will undoubtedly be considerable effort made to increase its usage as a wet-end additive.

"The degree of fiber bonding which may be obtained through the application of starch to paper via the size press can be of such magnitude as to replace a substantial portion of the strength which normally must be developed through mechanical hydration.

"Only a limited gain in strength can be expected if the starch cannot wet the fibers and impregnate the paper. Starch pastes have high surface tensions comparable to that of water itself and must be rated as poor wetting agents. This is particularly true when it comes to wetting a rosin sized sheet.

"The presence of filler in the sheet, some 5 to 15%, will also aid in ease of impregnating the paper.

"The gain in porosity resulting from a reduction in mechanical hydration will likewise increase the amount of starch pickup.

"Therefore, if we start with a paper which is soft and relatively porous because of the presence of filler and lack of beating and that also has only a trace of rosin sizing, we should expect to develop an exceptionally high degree of fiber bonding. Waxes of 15 to 20 are not unusual.

"Other benefits obtained are obvious. The stock, having received less mechanical hydration, will have less slowness. The paper should, because of the reduction in refining, have better dimensional stability, less cockles and curl, higher opacity, and a greater degree of compressibility. Savings in pulp costs may also be realized through the use of a high proportion of short fibers in the furnish provided you have not already reached bottom on cutting expensive long fiber.

"While I have stressed the importance of providing a paper stock which is specially adapted for ease of impregnation, there are, of course, other factors which have a bearing on size press operations. It is important to have the right type of starch. The fluidity and concentration of the starch paste must also be taken into account. Then the nip pressure can materially affect the amount of starch driven or forced into the paper. The moisture of the paper should not be less than 5 or 6% as it enters the size press as a drier sheet will not pick up as much starch paste."

Frank Kaulakis, technical service representative to the paper industry for Clinton Foods, Inc., Clinton, Iowa, was the last speaker. He covered the field of nonfibrous bonding agents such as starches, gums, proteins, etc. Mr. Kaulakis concluded that small gains could be accomplished by wet-end addition of such materials. However, the greatest potential field for these lies in size-press impregnation of paper combined with the use of fillers to decrease paper voids.

"Theoretically, fiber savings and other economic advantages are possible and the size-press application suggests possibilities for increasing paper tensile strength without beating and without appreciable loss in tear," he declared. Many interesting questions were raised following the talks, but lack of time prevented answering them thoroughly.

December Meeting

Kalamazoo Valley Section of TAPPI met the afternoon and evening of December 2 at the Hotel Harris, starting at 4:00 p.m. and continuing with dinner at 6:30, followed by a program featuring three speakers on the subject of "New Testing Instruments and Methods." Paul Applegate, treasurer of the local section, was in charge of the program of this meeting, and he had arranged an exhibit of newly developed instruments, which attracted much attention prior to the dinner. The speakers of the evening were present to discuss and demonstrate their products, also. Among the devices which excited considerable interest were the "Hurletron," an instrument for continuous measurement and control of sheet caliper and weight at the wet ends of machines, and the "curl gage," recently developed by the Sutherland Paper Co.

One hundred and twenty members and guests attended. James A. Dean, Michigan Paper Co., Plainwell, chairman of the Section, presided over the meeting. Richard T. Trelfa, Watervliet Paper Co., vice-chairman of the section and general program chairman, acted as master of ceremonies. Paul Applegate, Hercules Powder Co., Kalamazoo, introduced the speakers.

Frank W. Kearney, field engineer of Bendix Aviation Corp., Cincinnati Div., demonstrated and described the "Ultra-Viscoson," an instrument for automatically and continuously indicating viscosities. A thin metal probe is inserted into the liquid sample or stream and by magnetic means is caused to vibrate ultrasonically, somewhat in the manner of a tuning fork. The rate at which vibration dies away is a function of the viscosity of the liquid, and is measured electronically.

Gordon Wheeler, of the Lithographic Technical Foundation, discussed the "Development and Use of the L.T.F. Pick Tester." This instrument is designed to operate in the ranges of pressures, times of contact and rates of separation of ink film which prevail in actual printing operations. A remarkable fact demonstrated by means of this device is that on absorbent paper, due to absorption of ink vehicle during the time of printing contact, an ink can become three times as tacky as on a nonabsorbent surface. It has been shown, too, that paper which will "pick" in some printing plants will be entirely satisfactory in others.

William I. Wilt, of the Sheffield Corp., Dayton, Ohio, introduced two instruments similar to each other in principle, the "Sheffield smoothness tester" and the "Porosimeter," both of which yield instantaneous readings, unlike previous devices for measuring smoothness or porosity. The rotameter principle is employed for measuring rate of air flow, an idea which has been adapted from the metal working industries, where it is used to measure close clearances. In 1 min. Mr. Wilt performed tests which by standard methods would have required an hour or more.

Mr. Wilt introduced Pat Emmons, the engineer who has developed these instruments. That they should be shown in this meeting reflects the alertness and interest of the Kalamazoo area mills, since it was only in October that they were first shown in their present form, at the TAPPI Testing Conference in Dayton, Ohio.

ROBERT T. ELIAS, *Secretary*

Lake Erie

The third meeting of the Lake Erie Section was held at the Hotel Carter on Friday evening, Nov. 12, 1954.

There were 24 members present. The speakers, Donald Black of the Monsanto Chemical Co. plastics division, was introduced by the chairman, Lloyd Shand. Mr. Black's subject was "Synthetic Resins for the Paper Industry."

His subject was very timely and well received, and raised many interesting questions during the question period and after the meeting.

JOHN F. RICHMOND, *Secretary*

Synthetic Resins for the Paper Industry: New Horizons

Donald M. Black

WE AT the Plastics Division of Monsanto were sincerely pleased to receive Lloyd Shand's invitation to talk to you tonight because we have a story to tell you. We are enthusiastic about the progress taking place at our research and development headquarters—progress directed toward more effective service to the paper industry by our technical and sales staffs. We appreciate this opportunity to speak, therefore, because first we can tell you what we are doing, and, secondly, we can describe a few of the new resins and plastics promising to the paper industry we are bringing along.

These materials are a heterogeneous group, and fortunately so, since the audience tonight represents a wide cross section of the paper industry. I am reminded of an incident described in Bruce Catton's most recent book on the Civil War, "A Stillness at Appomattox." He describes how, at the end of day's confused and hectic battling, the Union soldiers would fall asleep where they lay, regardless of unit or type of service to which they belonged. In those days, the infantry was waked by means of a drum roll, while reveille for the cavalry was noted by a bugle. So well trained—and fatigued—were these men that a bugle blast in the ear of an infantryman would not wake him, whereas a distant drum roll would, and vice versa. So it may be tonight; I will try to hit as many subjects as possible so that each of you may hear his own bugle or drum and find something of interest.

Several weeks ago, while I was collecting notes for this talk, Frank Ash, who is the president of the Oswego Falls Corp., stated that the United States demand for paper by 1980—only 25 years from now, will reach 100 million tons a year. This figure is about four times what it is now, and the rate of increase, of course, is at a much greater rate than that of our country's population. Obviously, to fulfill this potential growth the paper industry will not only have to make existing paper products perform better, but will need to create entirely new uses for paper, undoubtedly in fields as yet untouched. We in the chemical industry hope to share this opportunity with you.

The recent, well-publicized reorganization of Monsanto has resulted in the transfer of part of the company's Paper Application Research Group to the Plastics Division. Monsanto has always recognized its responsibility in helping its customers solve their problems; the Plastics Division, just prior to the announcement of the reorganization, had implemented this recognition by authorizing the construction of a million and a quarter dollar building devoted to technical service and application research.

The upshot of this is that we are welding three elements into a single unit designed for your service: (1) an experienced paper research group, (2) a tremendous research resource—our new laboratory plus its personnel expert in resins and polymers, and (3) a wide variety of synthetic resins and plastics in every stage of development from the gleam in the mind's eye of a chemist to products now selling in large volume for end uses not connected with paper. Monsanto, as you may know, is the only resin manufacturer in the country that is commercially involved in the manufacture of the so-called "big six" types of synthetic polymers: styrene, vinyl chloride and acetate, the cellulosics, polyethylene, phenolics, and aminoplasts. All that seems to be lacking, therefore, is an awareness on *our* part of the specific problems bothering *you*, and I hope tonight will be the first step in removing that obstacle.

Since we are limited in time tonight, let us look only at representatives of the class of synthetic resins and polymers most likely to be of interest to you, namely, those soluble in water, available in at least semicommercial quantities, and, very important, usually lower in price than other synthetic water-soluble resins on the market.

We have approached the problem of providing water-soluble polymers by the copolymerization of a truly "organic" monomer, that is, one water insoluble, with an acidic molecule, often an anhydride. We can then obtain handleability in water of the various types of resins by first forming alkali salts by reaction with sodium hydroxide, soda ash, ammonia, organic amines, and the like. Let us consider as our general structure that molecule.

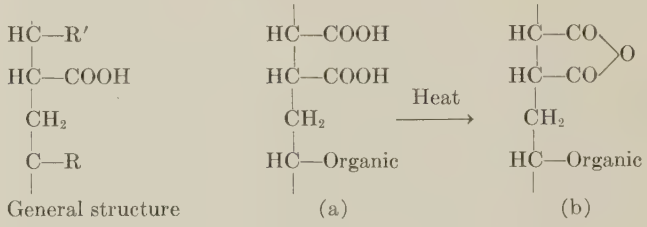


Fig. 1

Now look at the tremendous versatility this general structure gives us—not only in what we can do with that reactive acid group, but also how we can vary first the nature of R and R′, and second, the relative proportions of the organic monomer and the acid group. And these points of modification are in addition to those usually available in most synthetic polymers such as length of chain, amount of crosslinking, pH, and the like.

For example, let us look first at the case where R is aromatic—that is, related to benzene—and R′ is another acid (or carboxyl group). Actually, the two acid groups exist as an anhydride in this molecule (Fig. 1b) as shown. The resulting polymer is probably the most versatile and widely adaptable synthetic resin available to the paper industry today. It is entirely free from extraneous inorganic salts such as sodium chloride or sodium sulphate which may be corrosive to metal. The material is commercially available in any quantity and is rapidly proving its effectiveness in a wide range of applications in your industry. For one thing, the resin itself is very resistant to water; water resistance, of course, is often a desirable property to impart to paper. In spite of the water insolubility of the parent resin, we can handle it easily by first dissolving it in dilute aqueous ammonia in which it is readily soluble. The resin can be applied to paper or paperboard as this soluble ammonium salt by any of the conventional means—size press, tub, or calender stack.

When the paper is subsequently dried, the ammonia in the

DONALD M. BLACK, Product Development, Plastics Div. Monsanto Chemical Co., Everett, Mass.

salt evaporates and the resin reverts to its acidic, water-insoluble form. The time required for this evaporation reaction, so to speak, to take place is directly proportional to the heat available for the drying step. If we simply wound up the wet web and let it dry spontaneously, months might be required for any appreciable water resistance to be obtained from the resin. Fortunately, however, a surface sizing operation on a paper machine is usually followed by a number of drying rolls, so that the loss of ammonia is satisfactorily complete by the time the paper comes off the machine.

We can do even more. In this latter case in paper manufacture and in those instances in board manufacture where there is a drier section after the calender stack, we can increase manyfold the water resistance imparted to the sheet by the addition of a little formaldehyde to the aqueous solution of the resin's ammonium salt. Since we started with an anhydride group in the parent resin molecule, the solubilization reaction with ammonia leads to the easy formation of not only the ammonium salt but to a significant amount of amide groups scattered along the linear chain of the resin. These reactions are portrayed in Fig. 2.

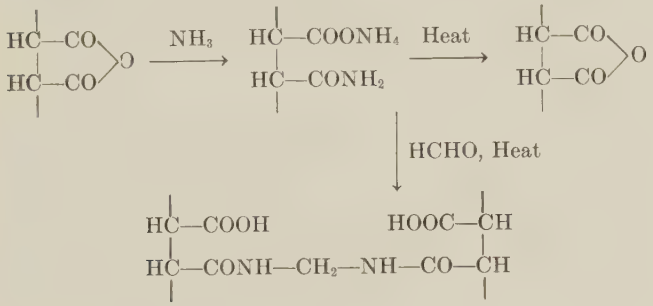


Fig. 2

Although the mixture of ammonia-resin and formaldehyde is perfectly stable in solution, once the water is removed by a definite drying step, the amide groups and the formaldehyde quickly react to form a cross-linked structure which is extraordinarily water resistant. The same effect can be obtained by two bath or two water box treatments with the ammoniacal resin in one and either formaldehyde or alum in the second.

Parenthetically, I can call to your attention what some of you may have noticed already—the similarity between this amide portion of the structure and the amino groups in glue. What we have been talking about thus far in terms of insolubilizing ammonium salts of this resin by heat or by reaction with formaldehyde is simply another way of saying denaturation which is what we call what we do to glue or gelatine by exactly the same reactions. Perhaps, therefore, the solutions in ammonia of this and the other resins I will discuss tonight may be of interest as means of improving those operations where glue is now used—tubsizing of blueprint paper, saveall systems, pigment and fiber retention, and the like.

As examples of what can be done along these lines, Table I tabulates data from actual mill work with two widely different types of stock—one a very lightweight saturating tissue and the other a heavy lined boxboard. Incidentally, the wet strength of the paper, which contained melamine-formaldehyde resin, was increased almost fivefold over that imparted by the melamine resin. Dry strength increased over 50%.

Table I

Paper	*%, Solution applied*	*Water resistance*
Saturating	0	0 sec. (penetration)
	3	37 sec.
Lined boxboard	0	4 min. (drop test) 1.6 g. (Cobb)
	2	40 min. 0.15 g.

Without going into detail, we should note that, if our water-resistant paper or board must be capable of being folded or creased, the resin can be *plasticized* in its aqueous solution either externally by such materials as the oleic acids, or, better yet by far, internally by the use of materials such as polyglycols, glycerol, and the like. These compounds will react with the resin to form again a water-resistant cross-linked structure, but one which is also more flexible. Diamines will react similarly; so will glyoxal. These are but examples based upon one soluble form of one of our resins to begin to demonstrate the wide potential of these resins new to the paper industry.

To continue, if we dissolve the parent resin in aqueous sodium hydroxide, sodium bicarbonate, or soda ash, the very soluble sodium salt is formed. This material—which is already available commercially as the dry sodium salt possesses a high ratio of ionic character to unit weight (in fact, possibly the highest of all the resins on the market). It would, consequently, be expected to be inherently a barrier to organic, or water-insoluble, materials. One such material is printing ink. If we apply an aqueous solution of this sodium salt to a paperboard at the calender stack, printability of the board, as affected by both a filling and smoothing action and by the barrier action against organic solvents, should be markedly improved. Such has been proved to be the case on a commercial scale, on boards as widely divergent as unbleached kraft liner on the one hand and the finest bleached foodboards on the other. Advantage can be taken of the fact that the resin is perfectly compatible with starch and its many modifications and can depend upon the latter for a bulking action to obtain a maximum improvement of printability at a minimum cost.

One other reaction which this parent resin can undergo should be touched upon briefly. The reactive anhydride group will react with alcohols to form so-called half-esters, in which one of the acidic groups has been combined with the organic part of the alcohol while the other remains free and available for further reaction as a carboxyl group (Fig. 3).

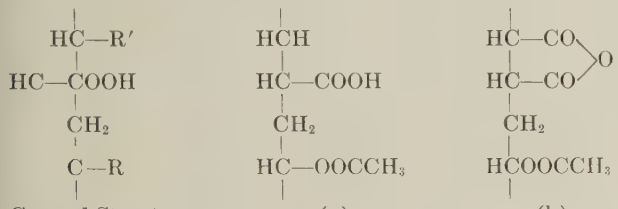
Fig. 3

These half-esters, one of which, the secondary butyl half-ester, is commercially available, have found commercial use in specialty clay coatings because they afford a means of obtaining excellent web rub resistance and improved flow properties, plus the advantages of exact reproducibility from batch to batch expected from a totally synthetic resin. They print exceptionally well and have excellent ink absorption and varnish hold-up properties. The folding endurance of coated papers is better than those made with the more brittle casein and starch binders, and they are perfectly compatible with other materials such as starch, casein, or synthetic polymer latices.

This type of resin is also used as a clear top coat, again applicable from an aqueous solution, for papers requiring high gloss or block resistance together with outstanding water resistance; decorative papers, such as shelf and wall papers, would be a good example. If the solution is applied at a tub or size press, greatly improved sizing, pick resistance, and strength are obtained. This resin can also be used as an ingredient in a resin coating based upon a material that would normally block to eliminate sticking.

Let us return for a moment to our basic resin structure (Fig. 4). If we let R be an acetate group and R′ be a hydrogen atom, we have a polyvinyl acetate resin (Fig. 4a). Polyvinyl acetates have received a considerable amount of attention from the paper industry—particularly the converting end—as potential means of obtaining relatively inexpensive

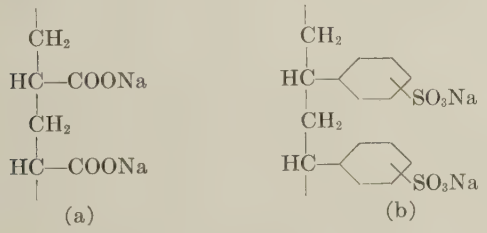
grease-resistant coatings. I specify "particularly from the converting end" because polyvinyl acetate resins based on water systems, which would be the form required by your industry, are normally supplied as emulsions (insoluble resin particles suspended in water) which are somewhat finicky to handle. They are mechanically unstable and, consequently, cannot usually be handled satisfactorily under the rigorous conditions encountered on the machine itself. Moreover, some type of fusion operation based on a high temperature is required for a continuous film. But you will note in the structure that we still have present our acidic portion of the resin molecule. Therefore, we simply dissolve the resin in aqueous caustic, or better yet, dilute ammonia, and apply the solution anywhere we want to, on or off the machine. The resin, when dry, forms a continuous, grease-resistant film; and, if we have used ammonia as our solubilizing agent, the reversion to the acidic form upon drying leads to a film also highly water resistant. If the paper or board with the grease-resistant film must be folded or creased, the aqueous solution can be plasticized by any one of a number of conventional means, including food grade plasticizers if such are required. If it is desirable to color or pigment the film, the necessary compatibility is present. This type of resin dries to an exceedingly high gloss, and can be used as a heat-sealable coating if desired. It is available commercially in three different viscosities, so that considerable latitude of choice is available for the solution of any specific problem.



General Structure (a) (b)

Fig. 4

If we further modify this structure by letting R′ be another carboxyl group (resulting in an anhydride structure as noted before) (Fig. 4b) and also increase the ratio of acidic groups to acetate groups in this type of structure, we can obtain a new species of resin which, although generally similar in its behavior to those previously described in that it increases wet and dry strength, fold and burst, is unique in that it is soluble in water alone or even in dilute acid. It is an entirely new resin as far as the paper industry is concerned, and should be of interest where acidic papers—those that cannot tolerate exposure to alkali—are concerned. Its low pH is not as harmful to paper as inorganic compounds of equal acidic would be, and the resin can be insolubilized by treatment with polyvalent cations.



(a) (b)

Fig. 5

The materials I have discussed so far are those with which we have carried out sufficient work in the laboratory and in the paper mill to enable us to make specific observations about their respective utilities in recognized problems in the paper industry. There are still other water-soluble resins with chemical structures entirely different from those described before which may be of interest to you in applications for which we can make no recommendations because of our ignorance of your specific needs. One such is a water-soluble sodium polyacrylate, in which the carboxyl groups occur singly instead of in pairs (Fig. 5). This resin will increase the viscosity of paper coatings and will greatly improve wet and dry strength, fold and burst.

Again, a new resin with markedly different structure is sulphonated polystyrene, available in two viscosity forms (Fig. 5b). You will note that this material is a second approach to making available in a water-soluble form a resin that heretofore has been available as a resin emulsion. This resin is unusual in that viscosities of solutions prepared from it are totally independent of changes in pH.

In addition to these many types of water-soluble resins, we are constantly experimenting with a large number of commercially available emulsions, organosols, plastisols, sheeting materials, and other types of polymers I will not go into tonight. I have mentioned the well-known interest of the paper industry in polyvinyl acetate emulsions (of which we have six, I might add). But what can the paper industry do with aqueous polyvinyl butyral emulsions (based upon the same resin used in automobile safety glass)? Or polystyrene emulsions? What can be done with polyethylene outside the laminating field? Consider Krilium, since it is useful in agglomerating soil, shouldn't it be effective in water purification or saveall systems?

Look at the wet-strength resins. We are familiar with the conventional urea and melamine-formaldehyde types (and I might insert parenthetically we have just introduced a new melamine-formaldehyde wet-strength resin). These materials are dependent upon a heat-induced polymerization of the resin itself for their effectiveness. We are producing commercially for a nonpaper use a new type of formaldehyde-containing resin, based on a relative of urea, which is unique in that it tends not to react with itself as do melamine-formaldehyde and urea-formaldehyde, but rather with the hydroxyl group in the cellulose molecule to form a stable, water-resistant bond. We are investigating this resin as a means of imparting dimensional stability to paper and paperboard; perhaps other possible uses will occur to you.

The main point of this whole discussion is to relay to you our sincere desire to be of assistance to you; we think we have the resources to aid you, and I hope the foregoing brief description of the chief resins we have available will suggest possible answers to your problems.

Empire State (Eastern District)

The November meeting of the Eastern District was held at the Glens Falls Country Club with 130 members present.

The meeting was called to order at 9:10 p.m. by Chairman Grant Cole. Minutes of the previous meeting were read. The following correction was made: Fred Sommerville is chairman of the Empire State Section. The minutes were then approved as read.

Ralph Prince was introduced. Mr. Johnson spoke on committee work and asked for suggestions regarding tests, testing methods, etc. Tal Edman asked for membership renewals and new members to our local section.

A testing instrument for determining printability of paper was exhibited.

Karl Kroetz asked for a conscientious approach to the question of reservation cards in order that we may have a better meal more closely on schedule. He asked that local members call him at Finch, Pruyn Co. and advise him of any last minute additions or cancellations.

Vince Long announced "Flat Screens" as the topic for the meeting of December 16, followed by "Bosses Night" on January 20, and "Synthetic Fibers" on February 17.

Mr. Long introduced the following speakers of the evening: A. E. Moyer of Snyder Chemical Co. who gave a paper entitled "Some Recent Developments in Beater Addition of

Phenol Aldehyde Resins"; Roger L. Steller of B. F. Goodrich Co. who spoke on "Addition of Latices to Pulp Supply Systems"; and Jack Hickman of Du Pont, who spoke on "Neoprene and Other Additives."

Following the three interesting presentations, there was a lively question and answer period.

RICHARD J. COLLINS, *Secretary*

Empire State (Northern District)

The November meeting, Northern District, Empire State Section, was held on Thursday, November 11, at 7:30 p.m. at the Hotel Woodruff in Watertown. Seventy members were present. J. D. Parmele, chairman of the TAPPI Award Committee, requested members to try to encourage contestants to submit papers for the April meeting. Chase Mather also announced that there would be a Clarkson Institute of of Technology alumni luncheon at the February TAPPI meeting in New York, and requested that those interested in attending contact him.

The program consisted of a talk by Edward J. Michel of Syracuse, a sales and human relations consultant. Mr. Michel has had considerable experience in sales, newspaper, advertising and circulation promotion field; and has instructed thousands of adults in the field of human relations and speech through sales clinics.

Mr. Michel gave a very interesting talk stressing the value of human relations to engineers and technicians in their business and professional contacts, and discussed many industrial problems which are caused by poor human relations techniques.

ELIZABETH L. CASE, *Secretary*

Empire State (Metropolitan District)

On Nov. 9, 1954, about 50 members of the Metropolitan District, Empire State Section of TAPPI, made a plant visit to the paper mill and box shop of the Gibraltar Corrugated Paper Co., Inc. in North Bergen, N. J.

Following the plant visit the regular dinner meeting was held at Fraunces Tavern in New York City. About 60 people were at the dinner to hear Joseph Theriault of the Robert Gair Co., Inc. speak on "The Practical Application of Statistical Quality Control in a Board Mill."

Mr. Theriault explained how to go about setting up a statistical quality control system in a board mill. If possible he recommended introducing the statistical quality control system in the box shop rather than the paper mill. He suggested the following five points be investigated in starting a statistical quality control program: (1) make sure all instruments are standardized, (2) make sure the operators know how to properly use the instruments, (3) record data in an easy to understand form, (4) find from the salesman how many and what kind of complaints you are getting, and (5) introduce the use of statistical quality control in the mill gradually.

Mr. Theriault's talk was followed by a very interesting discussion period.

L. E. GEORGEVITS

Empire State (Central District)

The Central District of Empire State TAPPI met at 7:00 p.m., November 5, at the University Club, Syracuse, for its monthly dinner meeting. There were 108 in attendance.

Seated at the head table were S. Earll Church, treasurer; Keith Johnson, senior, New York State College of Forestry, and newly elected president of the Papyrus Club; Durwood Geffken, vice-chairman; Jesse Ray, Scott Paper Co.; F. W. O'Neil, chairman; B. H. Wortley, secretary; James H. Perry, Norton Abrasives; C. P. Donofrio.

Seated (l. to r): J. W. Morrow, Newton Falls Paper Mills, Inc.; B. H. Wortley, Solvay Process Div.; J. D. Lohnas, Newton Falls Paper Mills, Inc. Standing (l. to r.): Ralph Prince, Fort Orange Paper Co.; Durwood Geffken, Oswego Falls Corp.; F. W. O'Neil, College of Forestry, State University of New York; F. G. Sommerville, Armstrong Cork Co.

Mr. Geffken introduced Mr. Ray of the Consumers' Representative Dept., Scott Paper Co., who spoke on "Quality Control." Mr. Ray emphasized the extensive consumer research program carried on by the Scott Paper Co. before they put their new napkin "Scotkins" on the market. An interesting discussion period followed.

December Meeting

The Central District of Empire State Section of TAPPI met at 7:00 p.m., December 3, for its monthly dinner meeting. There were 103 in attendance.

Seated at the head table were S. Earll Church, treasurer; F. G. Sommerville, chairman, Empire State Section; Durwood Geffken, vice-chairman; John Lohnas, technical director, Newton Falls Paper Mill, Inc.; F. W. O'Neil, chairman; J. Wayne Morrow, paper mill superintendent, Newton Falls Paper Mill, Inc.; B. H. Wortley, secretary; Ralph Prince, treasurer, Empire State Section.

Mr. O'Neil introduced those seated at the head table and also a special guest, W. W. Jackson, superintendent, Springhill mill, International Paper Co.

Mr. Geffken introduced the speakers from the Newton Falls Paper Mill, Inc. Wayne Morrow spoke on the "Waste Paper Conversion at the Newton Falls Paper Mill, Inc." and John Lohnas presented a paper entitled "Some Technical Aspects of Waste Paper Conversion." These papers were well received and an interesting discussion period followed.

BARBARA H. WORTLEY, *Secretary*

Waste Paper Conversion at Newton Falls Paper Mill Inc.

J. Wayne Morrow

THE conversion of waste paper is as important to Newton Falls as the pulp operation is to the large mills in the south. Actually we think of it as our pulp mill, for 75% of our fiber furnish is produced there.

The grades of paper made in the paper mill use from 100% converted fiber to 100% virgin fiber. In the use of the three main types of waste, namely, cups, ledger, and magazine, a close check is made to keep the per cent of each grade used from day to day as uniform as possible so that the fiber de-

J. WAYNE MORROW, Paper Mill Superintendent, Newton Falls Paper Mills, Inc., Newton Falls, N. Y.

livered to paper mill runs uniform from day to day. This is vitally important for paper machines may make as many as three to six different grades in any 24-hr. period. Only on very special grades of paper made is the furnish changed in the waste conversion.

To maintain a constant furnish to the conversion process, regardless of how shipments arrive, two storages are maintained—one small active storage; the other large, from which a shortage of any one grade in the daily shipments can be made up.

All paper is handled by towmotors from box car or truck to storage to pulpers. Unloading is done on an 8-hr. basis; conversion is a 24-hr. operation.

At this point I think it will be wise to split the balance of this paper into two parts: first, a short description of the flow of the operation, and then a detailed description of the various individual steps in the conversion.

The bales are placed on the ramps of one of the two pulpers, bale wires cut, paper inspected, and then pushed into pulper. From pulpers slushed stock is sent to the cook tanks. This is batch operation so far, but from cook tanks the stock is dropped into a black stock chest from which the stock is continuously pumped to a mixing or stuff box, after the mixing box to the Jonsson screen, from here to the Ahlfors screens. A battery of Dirtecs then receives the screened stock to send it to the washers: first, a vacuum washer and then through two Lancaster washers. After the black stock washing and consistency regulation, bleach is added and the bleaching is done continuously in a large tile-lined chest. The bleached stock is washed and sent directly through a consistency regulator to storage chest in paper mill, ready for use on the machines.

Now to go into detail on the various steps in the conversion. Two 14-ft. Dilts pulpers are used. These pulpers have a standard rotor driven by 150-hp. motors. The vat is 4 ft. higher than standard pulpers to give a capacity of 6000 to 7000 lb. of stock at a consistency of 7 to 8%. From two old digesters, from the old sulphite process that has been converted to hot water heaters, the pulpers are supplied with 160 to 180° water. Exhaust steam and live steam is used to raise temperature of stock, if desired. Caustic is added through meters and measuring tanks.

To load pulper about two thirds of water is put in and then caustic. With pulper running, paper is added and, since most pulpers are brought up to 200°F., the steam is added while paper is being added. Caustic used averages about $4^1/_2$% of weight of paper. The rotor of both pulpers has been stellited to give better defibering. Caution must be used in stelliting a rotor for this can add a tremendous load on the motor and easily cause motors to burn out, especially during the initial stages of loading. In these pulpers we do 95% of the ink saponification and defibering. This is the result of the chemical and mechanical action aided by heat. Small wire bottom boxes are used to wash out samples of stock to determine progress of the work on stock and to determine when it is ready to be dropped out of pulper. Plates in bottom of pulper have $^1/_4$-in. perforations.

From the hydrapulpers the stock is pumped to one of two tile-lined cook tanks. These tanks have a mid-feather wall, sloped bottom, and Agiflow pumps for agitation and will hold 12,000 lb. at 6%. These cook tanks have a threefold purpose: extra chemical can be added, additional defibering takes place, and also storage; storage because many pulper charges need no further mechanical or chemical work done on them. Steam can also be added, if necessary. Before stock is continued on its course through the system, it is again sampled in boxes and a handsheet is made. Both dry and wet observation of the stock is necessary to be sure stock does not contain any foreign material that we know cannot be removed in the next steps of the operation. If any questionable material such as ink balls, rubber, plastic films, or any one of the several hundred other objectionables are found, several more hand sheets are made to determine the extent of the material and a decision made as to whether the stock can go on or be dumped to sewer. Any bad stock allowed to pass this point can cause many tons of off-grade paper in the paper mill.

After the cook tanks the stock is dropped into the black stock chest and flows continuously from here through the rest of operation to storage chest in paper mill. This chest holds about 15,000 lb. at 6% and has one paddle agitator.

From the black stock chest the stock is pumped to the stuff box. This box has three compartments: one that stock flows out of through a weir with an overflow gate to vary head on weir to give visual control of stock flowing into system. Excess stock goes back to chest. Second section is used to measure flow of water into third section where stock and water are mixed.

The stock from stuff box flows into a cone-bottomed cylinder that we call a pin trap. Total height is about 10 ft. and it is 24 in. in diameter. Inside the main cylinder is a 12-in. cylinder that goes to about 3 ft. from the bottom. Stock flows into main cylinder down and then up through 12-in. cylinder and out into Jonsson screen. Heavy metal settles in the cone bottom and is removed as necessary through a 10-in. gate valve on the bottom of cone. Plans now call for magnetic separators to increase the efficiency of pin trap, thus taking some of the load of screening out metal by the Jonsson screen. This will also minimize the wear on the screen plate of the Jonsson. Mechanical wear on the screen plate must be considered as well as chemical action. Experience has shown in our case that bronze-type plates are not satisfactory.

The Jonsson screen takes out pins, clips, wet-strength chips, wood, rubber bands, and many other materials. The screen plate is of mild steel with $^3/_{32}$ in. perforations. We have found that this size perforation is most satisfactory to our conditions. The larger perforations let too many metal clips and paper chips through. Smaller perforations did not have the necessary capacity. It has also been found necessary to use a large amount of shower water on the last third of the screen to give the best screening and to insure stock not flowing over reject and of screen at all times. Good stock going over the end of screen is a total loss.

The next step in cleaning of stock is to deliver it to the Ahlfors screens at a consistency of about 1%. This is the first installation of this type screen in waste paper conversion. All previous installations have been for virgin pulp mills or similar plants. The two screens we have have so far proved themselves to be an improvement over the old flat screens from the standpoint of cleaner stock. They remove chips and ink balls much more efficiently, and as for fine heavy dirt, it does not get the chance to go through screen due to accepted stock flowing up through plates rather than down. The screen plates are chrome plated bronze with 0.012-cut slots. These screens have a vibrating diaphragm below plates. Stock flows between diaphragm and plates. The diaphragm vibrates as high as 1300 pulsations per min. With a recommended head of stock on the plates of 12 to 18 in. and the rapid fire pulsations, the stock screened per slot is very high. These screens have screened as high as 70 tons of stock and the plate area is about one quarter of what we had for flat screens previously that had to be pushed to the limit to get 60 tons. Automatic traveling showers with 80-lb. water pressure clean the plates once every 60 sec. This shower is very important and without it the screen's production falls off considerably. Rejects from the screen are removed through a slotted adjustable tube to a tailing screen. The adjustment of the flow of rejected stock through this slotted tube is very important to the cleanliness of stock. This tail screen is the old conventional type flat screen, has eight plates with 0.008-cut slots. This screen takes the rejects from Ahlfors from good stock that must necessarily be removed at the same time. Accepted stock from tailing

screen goes directly to Dirtec units, as does accepted stock from the Ahlfors. Final rejects go to sewer.

The next step in cleaning of stock is to put it through a Dirtec battery composed of eight primary units of 250 g.p.m. capacity and eight secondaries. Dilution water is added to reduce stock to a consistency of 1/2 of 1%. A 40-lb. pressure is maintained on these units. A foam killer is added to stock ahead of these units to give better cleaning here and to give better operation of stock as it goes over the washers.

Two lines of washers receive equal amounts of the stock directly from Dirtec units. Each line is composed of an 8-ft. vacuum washer and two 5-ft. Lancaster washers with a whipper unit between each washer. The water from the vacuum washer goes to sewer. Water through Lancasters is counter flow to the stock. Wash water for the Lancasters comes from the bleach washer and is supplemented with white water from paper machines.

At the end of these two lines of washers, stock is diluted with paper machine white water and goes through a consistency regulator to the bleach chest at 4% consistency. As the stock flows into the bleach chest, sodium hypochlorite bleach is added and temperature brought up 125°. The stock is retained in chest about 2 hr. This chest is tile-lined, has a sloped bottom with a mid-feather through the center of chest. The stock is agitated and circulated through chest continuously with a bleed off line from the circulating pump to flow bleached stock to washer at a rate demanded by the paper mill. The bleach washer is a single Lancaster similar to those used for the brown stock. Paper machine white water is used to wash the bleached stock. Washed bleached stock is pumped through a consistency regulator at 4% directly to a storage chest of about 15,000 lb. capacity, ready for the paper machine system.

The horsepower consumption is 12 per ton of stock, and steam is 6500 to 6900 lb. per ton.

Some Technical Aspects of Waste Paper Conversion

John D. Lohnas

MANY individuals regard the utilization of waste paper as strictly a junk business. This, however, is far from a true picture when it is taken into consideration that between 25 and 30% of the paper and board manufactured in the United States is made from recovered fiber in the form of waste paper. Thus it would appear that the utilization of waste paper is big business and is very important to the American economy.

STANDARDS AND GRADES

The National Association of Waste Material Dealers, Inc. have established a written code, the title of which is "Waste Paper Standards and Practices WP-54." These standards are supposed to be strictly adhered to by all members of the association. In many cases however the waste paper packers make a rather liberal interpretation of grade definition. For example, colored ledger is defined as "white and colored shavings of untreated ledger, bond, writing papers, and other hard papers which have a similar fiber content. This grade may include bleached sulphite or sulphate papers containing a trace of groundwood." Practically every bale of colored ledger coming into a plant could be rejected if the mill rigidly interpreted the grade by the definition previously given.

In the deinking operation at Newton Falls, colored and white ledger, cups, and magazines furnish the bulk of the raw material used. The contaminating materials which are found in waste paper bales may be classified as objectionable and prohibitive. Objectionable materials could be defined as those which do not belong in the grade but which, when appearing in limited quantities, do not seriously hamper operations or affect the paper quality. Prohibitive materials may be defined as those which may either seriously cause trouble in operation or impair the quality of the finished paper.

It must be borne in mind that there are no two mills processing waste paper in the same manner and very few which are making exactly the same grade of finished paper. Therefore, the materials which could be regarded as prohibitive in some mills would merely be objectionable in others.

CONTAMINATING MATERIALS

In the case of magazines there are only a few materials which cause trouble. These materials nearly all come under the heading of alkali-insoluble adhesives. These adhesives are either used as binders for the backs of heavy magazines, flying pasters from printing plants, or mill splices from the mills where the paper originated. Magazine bales as a rule contain very little foreign material. However, the outsides of the bales are sometimes moldy or dirty and excessive quantities of kraft wrapping may be encountered.

Some of the objectionable materials which are regularly found in ledger bales are: paper clips, pins, staples, rubber bands, tin foil, cellophane, rope, twine, cloth, burlap, hard rubber, wood, sawdust, excelsior, floor sweepings, sand, dirt, cigar butts, and even old automobile tires. Most of these materials can be effectively removed by pin-traps, rifflers, screens, and centrifugal separators. If found in large quantities, however, they can cause shutdowns until removed from the system.

Some of the prohibitive materials which may be found in ledger are as follows: wet ink concentrations wrapped in paper wads, asphalt, laminated wrappers, certain varnished or lacquered label papers, plastic laminated papers, heat seal papers, pressure sensitive adhesives, photostats, blue print, carbon paper, wax paper, chipboard, wet-strength, papers printed with vinyl inks, old brittle groundwood, and many others. The reasons for these materials being intolerable will be given later.

INSPECTION

Because of the occurrence of the previously mentioned materials in waste paper bales, it has been necessary to establish an inspection system at Newton Falls. Prior to inspection, two years ago, a considerable amount of fiber was dumped into the sewer because of contamination with prohibitive materials. After the establishment of inspection, the intentional "sewer-jobs" were reduced to as low as one tenth of the former tonnage loss. Inspection, such as is practiced at Newton Falls, does not entail paper sorting. The paper stock coming into the mill has supposedly been sorted by the packers.

In this system, the inspector, who answers to the technical control department, has the responsibility for grading or rejecting all bales of waste paper. There is an inspector on duty for each work shift and he is required to be present during the furnishing of every pulper. He keeps a complete record sheet for the shift with the following information: cook no., pulper no., packer's name, grade of paper, car no., date received, bale conditions, pulper condition, and other conditional remarks and explanations. He also keeps a complete record, by cars, of the condition of every bale from each car. In this way it can be determined which packers are the worst offenders involving the occurrence of contaminating materials.

If the quality of a bale of waste paper is questionable, the inspector has it set aside and notifies the laboratory. Samples are taken from the bale and given a standard pulping and bleaching treatment in the laboratory to determine whether the questionable paper is a usable source of acceptable fiber.

JOHN D. LOHNAS, Technical Director, Newton Fall Paper Mills, Inc., Newton Falls, N. Y.

The establishment of this system has paid off in several ways. First, the savings in dollars, because of a reduction in intentional "sewer-jobs," has more than made up for the wages paid to additional personnel. Second, the quality of the fiber produced by the plant has been greatly improved. Third, an orderly and accurate source of information has been given to both production and the technical department. This information was not previously available. Fourth, the purchasing department has been given accurate data concerning the condition of various shipments.

CHEMICAL ACTION

Many chemicals have been used from time to time at Newton Falls in deinking. At the present time, the only chemical which is regularly used is caustic soda. Sodium hypochlorite is used for bleaching.

Among the other chemicals which have been used are: sodium peroxide, zinc hydrosulphite, sodium polyphosphates, soda ash, sodium silicate, certain organic dispersants, various patented detergents, and diatomaceous earths.

Sodium peroxide has been used in the past for deinking papers with a high content of unbleached groundwood. The function of the peroxide is to prevent the discoloration of groundwood caused by caustic alkali. Zinc hydrosulphite has been used for the same purpose. In the case of zinc hydrosulphite, color reversion is encountered when the washed pulp is bleached with sodium hypochlorite. At the present time, neither chemical is being used because unbleached groundwood papers are not being processed. Zinc hydrosulphite has been successfully used in bleaching the dyes in certain hard colored papers which cannot be removed by oxidizing agents.

Sodium polyphosphates, soda ash, and sodium silicates have been used in combination with and in place of caustic soda. The function of the polyphosphates is to disperse various pigments in ledger and printing papers rendering them more easily washed out. No increase in brightness or other advantages were apparent in using phosphates. The added chemical expense could not be justified. Sodium silicate proved to be detrimental in that it would not wash out of the stock and caused an increase in alum consumption in the paper mill. Soda ash in combination with caustic soda acts slower and production is cut down.

It was found that when certain chemical detergents or organic dispersants were added to waste paper stock, that rubberlike adhesive materials were softened up and became "tacky." These materials were partially dispersed, passed through the deinking system, and were precipitated out with alum in the paper mill. They appeared as sticky particles on the paper machine dandy rolls, press rolls, doctors, and calenders. They also appeared in the finished paper as "stickers," even after coating. Such chemicals can be very dangerous to use.

Diatomaceous earths have been used from time to time for absorbing "ink-balls," "asphalt-balls," and various tacky, rubberlike materials. Their value for this purpose is somewhat indeterminant.

For best results in deinking, it has been found that a standard blend should be made of various kinds of waste paper such as ledger and magazine. This blend should be treated at 6 to 8% consistency while defibering at 180 to 200°F. with 3 to 5% of caustic soda. A uniform pulp is produced from the standpoint of strength, freeness, and bright ness. The caustic soda reacts with the dried vehicles of ink breaking the bonds between pigment and fiber. The ledger papers, being hard sized, provide rosin which reacts with the caustic to form a soap that acts as a detergent in washing the pigments and carbon black out of the magazine stock. The fillers found in magazine may provide a beneficial absorptive effect.

Further elimination of undesirable materials is accomplished by bleaching. In the case of deinked fiber, hypochlorite bleaching does not accomplish the same thing as in a wood pulp operation. In the latter case, natural products found in the wood are removed, whereas, a deinking operation usually starts with bleached fiber and is mostly concerned with aniline dyes found in the paper and inks. Carbon black and most mineral colors will not bleach and are only removed by washing. Sodium hypochlorite bleach is preferable for this operation over calcium hypochlorite. Lime bleach, because of its relative insolubility, may cause mechanical trouble by plugging washers cylinders. Also the lime is carried over to the paper machines with a detrimental effect.

In the bleaching operation at Newton Falls, from 0.5 to 2.5% available chlorine has been used on the fiber. Because of the lack of time available in the bleach chest, it is sometimes necessary to raise the chest temperature above the optimum for most efficient operation in order to obtain the desired brightness. Chest temperatures are controlled from 120 to 140°F. The brightness of the stock on the bleach washer is checked every hour by means of handsheets, using a Hunter reflectometer. Brightness values in the range of from 75 to 78 have been obtained.

At the present time, sodium sulphite is used as an antichlor and the final pH of the bleached fiber ranges between 8.0 and 8.5. An installation of antichlor control on the bleached stock by means of sulphur dioxide gas is nearing completion. It is expected that by controlling the injection of sulphur dioxide gas into the bleached stock at a pH of 5.5 to 6.0, a certain amount of color reversion on the paper machine driers can be eliminated. This new control system should accomplish three things, namely: antichlor, improved brightness of the paper, and pH control of the accepted stock going to the beater room.

SHRINKAGE

Because of variation in composition of the raw material, it is difficult to arrive at accurate shrinkage values for different grades of waste paper. One method by which these values may be obtained is to take samples from several cooks, remove the water by filtration on a filter paper, dry in an oven, and determine the amount and type of filler content from ash tests. This method does not take into consideration such organic materials as starch and casein, which are combustible along with the fiber. Moisture, sewer-losses, tare weight, and outthrows also have to be considered for the determination of total shrinkage.

By using the above method for determining filler or mineral content and correcting these values by using factors applied by the accounting department, which are obtained from a year's experience in over-all shrinkage, it is possible to arrive at a breakdown of shrinkage values. The values obtained by this method are as follows: white and colored ledger 14 to 16%, magazine 40%, cups 8%.

It should be mentioned that after washing, the deinked fiber retains approximately 3% ash. Also if the waste paper received does not contain any more moisture than the finished paper from the end of the paper machine, there is theoretically little moisture loss from the purchased raw material.

The Waste Paper Utilization Council has recently issued a tabulated bulletin to about 15 member mills. This bulletin gives the results obtained from the members by various methods of determining shrinkage. It was stated in the bulletin that further information is needed on this subject and a simple, accurate method should be developed.

PROHIBITIVE MATERIALS

The prohibitive materials, which were previously listed, will not dissolve or disperse in hot alkali. Portions of them will usually pass through the screens and washers and end up in the finished paper as balls, chips, or dark, pepperlike specks. Wet ink, asphalt, wax, and rubberlike adhesives usually end

up as balls or smears. Blueprint, photostats, old brittle groundwood, wet-strength, and certain plastic films end up as chips or flakes. Some overprint varnish label papers and inks made from vinyl resins will not saponify and the ink pigments end up as pepperlike specks which cannot be totally removed.

It can cost considerably when prohibitive materials get into a waste paper system. These materials are usually detected in the pulpers or cooking tanks from wash-out samples. When detected, the pulper load is dumped into the sewer. The cost of one of these "sewer-jobs" is estimated to be approximately $250. If the material is not seen and enters the continuous washing and bleaching system before detected, the cost can be considerably greater because of the subsequent loss in production and the increased tonnage involved. If, however, it gets into the finished paper, as high as 50 tons may have to be sold at a loss as a job-lot. It is possible that it may not be detected in the paper and the order goes to the customer. In that case, it can cost thousands of dollars with the loss of a customer.

Of all the materials encountered, the most troublesome are obviously those which cannot quickly be identified. They cannot be removed or the bale rejected because they are not seen before they enter the system. At the present time, the most serious problem is the presence of adhesive materials which are made from alkali-insoluble thermoplastic resins. These come under the heading of heat-seal papers, pressure sensitive, and other synthetic adhesives.

CONCLUSION

Probably too few people realize the quantity of potential waste raw material which is being made nonusable because of coatings and additives of various kinds in paper. One of the answers to this problem is to substitute, when possible, alkali-soluble adhesives for those which are not. A great deal of research is being undertaken along these lines by some of the large adhesive manufacturers. In the meantime, it is necessary to continue with the present program of educating waste paper packers and paper converters to prevent these materials from getting into regular grades of waste. Finally, efforts are being made by the mills themselves in cooperation with the chemical and machinery manufacturers to devise methods for removing these materials when they get into a waste paper system.

Empire State (Western District)

The Western District of the Empire State Section of TAPPI met at the Prospect House, Niagara Falls, N. Y. on Oct. 6, 1954, with 41 members and guests in attendance. The speaker of the evening, A. W. Hoffman, quality control manager for Robert Gair Co., Inc., spoke on "Quality Control Procedures in Corrugated Fibreboard Box Production."

A summary of Mr. Hoffman's talk follows:

"The basic objective of the procedures is to achieve and maintain a desirable quality of product. Aside from the fact that certain accounts have rigid requirements for their corrugated fiberboard boxes—and the number of such accounts is constantly growing—quality of product has an obviously salubrious effect upon sales.

"Quality control in this particular industry can be divided into three phases: pre-production measures, in-plant measures, and post-production measures. The first entails analysis of the properties of the roll stock used for the facings and corrugating material. This includes such determinations as basis weight, caliper, moisture content, bursting strength, rigidity, and potential flat crush resistance. The in-plant measures include inspection of the material during various steps of the manufacturing operation and simple tests which may include combined board caliper determinations, bursting tests, and flat crush tests. The post-production measures are confined to finished boxes and will include bursting tests, puncture tests, flat crush tests, combined board caliper determinations on printed and unprinted areas, and compression tests on boxes set up and sealed but without contents.

"In addition, the post-production measures include detailed examination of the containers to detect deficiencies in any of the fabricating operations.

"Normally, testing of corrugated fiberboard presupposes a prior exposure of the samples to controlled atmosphere. As recommended by TAPPI, this atmosphere is 50% R.H. at 73°F. and preferably the samples before exposure to these conditions will have been subjected to an atmosphere with a lower relative humidity so that moisture content equilibrium in the standard atmosphere is attained on an absorption basis. This conditioning is certainly necessary and is carried out for the pre-production and post-production procedures. However, it is not feasible for in-plant measures, chiefly on a basis of time.

"Adequate conditioning requires a minimum of 5 hr. of exposure (although usually samples are left overnight) and the delay imposed by such waiting would make it impossible to correct deficiencies in the quality of the product while it is still being made. This, of course, is the prime purpose of in-plant procedures and so the greater accuracy of result achieved through conditioning is sacrificed in order that remedial measures on the machines can be taken before the run is completed."

O. E. Anderson, Jr., *Publicity Chairman*

November Meeting

The Western District of the Empire State Section of TAPPI held a joint meeting with the Niagara Branch of the Technical Section of the Canadian Pulp and Paper Association at the Prospect House, Niagara Falls, N. Y., on Nov. 3, 1954. Ninety members and guests were present to hear a panel of three representatives of instrument manufacturers speak on the general subject of "Instrumentation."

Preceding the panel's presentation, was the showing of International Paper Co's latest sound film in color, "Paper in the Making."

Arthur Freilich of Minneapolis-Honeywell Regulator Co., Cassius S. Conner of Taylor Instrument Cos., and George F. Bearer of Industrial Nucleonics Corp. were the three speakers of the evening. Their talks were followed by a short discussion period. Summaries of the three talks follow:

Graphic Panels in the Paper Industry

Arthur Freilich

One interesting feature of instrumentation in the pulp and paper industry is the rapid acceptance and wide usage of graphic panels. Pioneered for the petroleum industry, the graphic panel features a large process flow diagram mounted or painted on the panel with miniature instruments located in the flow diagram at the points where they apply.

The graphic panel is not designed to replace conventional instrumentation; each system has its own merits. On a given installation, the mill must decide which type of controls will be of the most benefit. In general, graphics yield the greatest benefits on continuous processes, complex processes, or new processes where operator training is important. However, many factors should be taken into consideration when deciding which type of instrumentation is to be used.

Figure 1 shows a conventional instrument installation in the washer room of a large southeastern newsprint mill. Two lines of washers are installed in this mill. The conventional instrument panel for control of both lines of washers is located

Arthur Freilich, Paper Section, Industrial Div., Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.

Fig. 1

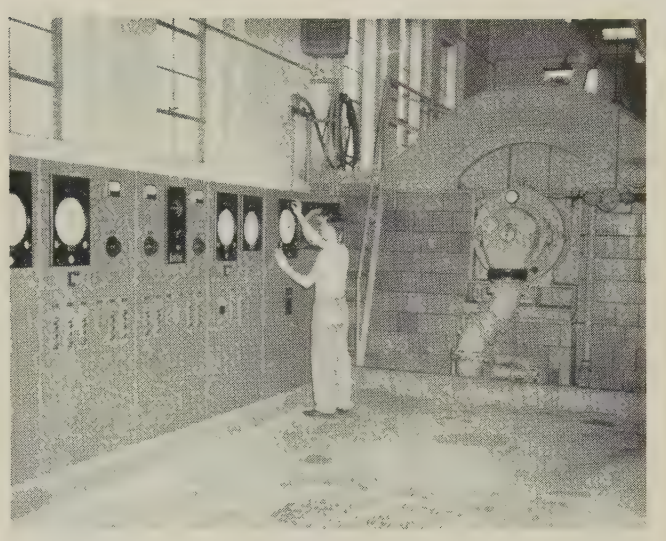


Fig. 3

at the far end of the floor. The left- and right-hand portions of the instrument panel contain those instruments which apply to the left- and right-hand lines of washers. The center portion of the panel contains instruments which are common to both lines.

Individual consoles are located at each washer. Each console contains the electrical controls and manual load stations which apply to that washer. This is a typical conventional installation.

A graphic washer control installation is shown in Fig. 2. One line of washers is used with individual consoles for each washer. The graphic panel can be seen at the end of the line of washers. The graphic diagram occupies the upper portion of the panel with miniature indicators mounted in the flow lines and process symbols. Several push buttons and control instruments are also mounted underneath the graphic diagram. Running lights to show when pumps and motors are energized are mounted in the graphic diagram directly in the pump and motor symbols.

This particular panel is the second graphic panel installed in the pulp and paper industry. Two conventional circular chart recorders are used on this panel. Below the graphic diagram in the center is a strip chart recorder which functions as a "master recorder" for the entire system. The "master recorder" gives a record of 16 variables on one chart section, thus providing management with a complete story of the operation of the system.

Figure 3 shows a conventional instrumentation system installed in a bleach plant in a New York State mill. This mill produces 100 to 130 tons per day of bleached pulp. The mill is operated by one operator per shift who is responsible for the equipment and controls and who also takes pulp samples and runs laboratory tests and quality control checks.

An equivalent graphic panel system for control of a bleach plant is installed in a large pulp mill in Maine as shown in Fig. 4. Individual consoles are used at each washer. The controls on each console are those needed during start-up. After the bleach plant has started up, control shifts to the graphic panel in the background. Figure 5 shows a detailed view of the graphic panel.

The entire panel is laid in a tile wall and consists of two sections. The right-hand section contains the graphic diagram with miniature instruments. The left-hand section consists of a conventional control panel with circular chart recorders and service gages. The conventional instruments are three-pen, circular chart recorders which provide a record of three variables on a single chart. In addition, these instruments totalize or integrate one of the variables, providing an easy means of determining consumption of steam or water in the bleach plant for use in cost analysis. This panel provides an excellent comparison between the size of miniature instruments and conventional instruments.

Basically there are two types of graphic panels. The panel shown in Figs. 4 and 5, with respect to its graphic por-

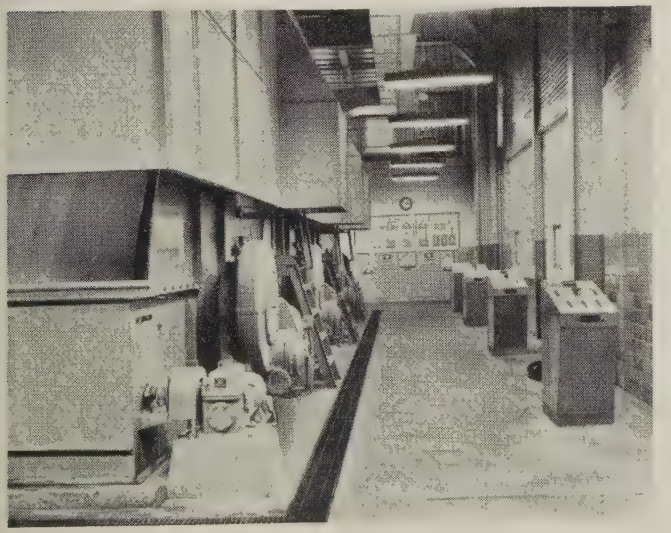


Fig. 2

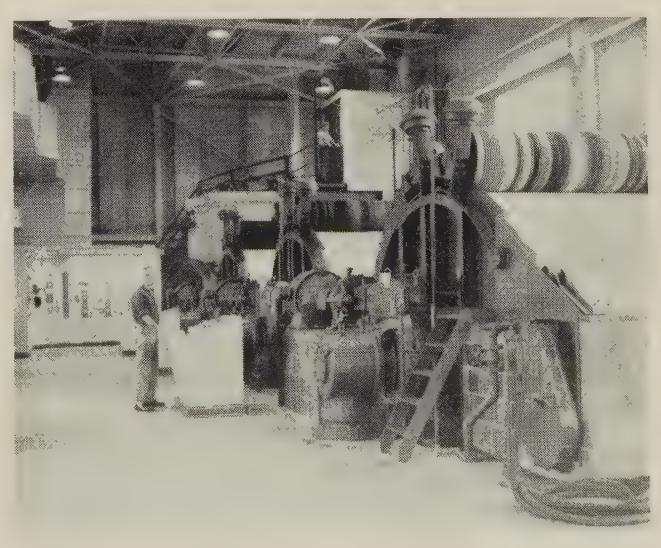


Fig. 4

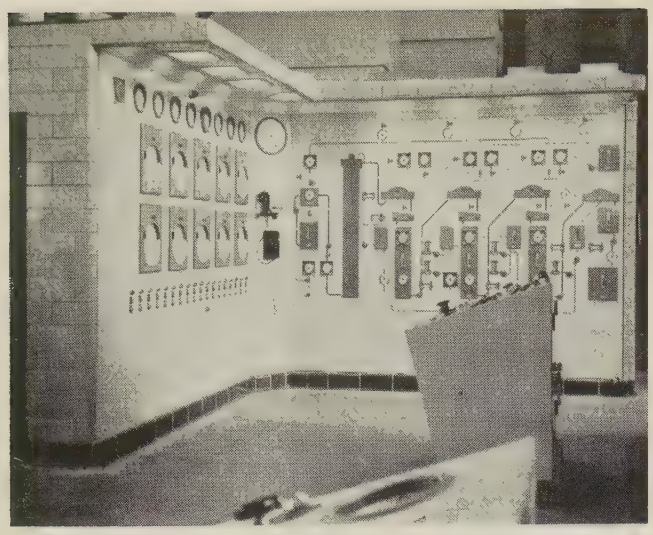


Fig. 5

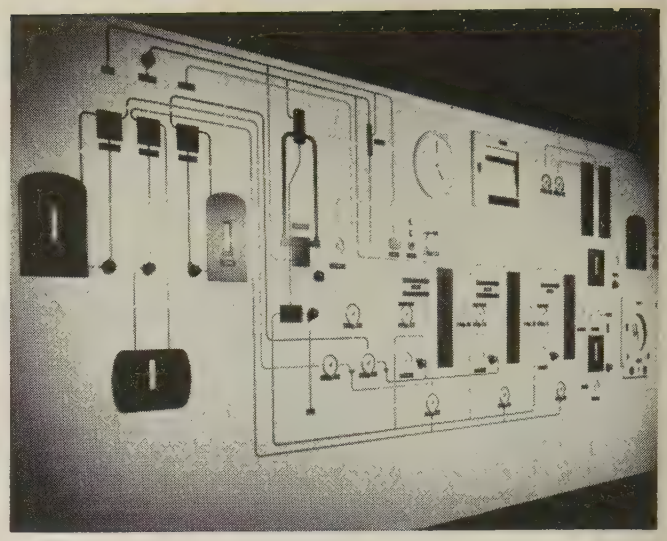


Fig. 7

tion, is a full graphic panel. By this we mean that the instruments and other equipment on the graphic panel are mounted directly in the flow diagram. In contrast to this is the so-called semigraphic panel. The washer control panel in Fig. 2 is of the semigraphic type; although the graphic diagram contains miniature indicators, the miniature control setting units, push buttons, and other control units are mounted below the graphic diagram. Since much of the equipment is not in the graphic diagram on a semigraphic panel, it is necessary to correlate the control setting units with the process symbols and indicators in the diagram. This is done by means of color symbols mounted in the process diagram and also in the instrument nameplates.

The areas of comparison between graphic and conventional instrument panels are so large that we can cover only a few of the most important. The first comparison that comes to mind is on the basis of cost. Practical experience shows that in most cases, the graphic panel initial capital investment will exceed that of a conventional control system by anywhere from 25 to 40%. Field installation costs for the graphic panel will also run somewhat higher than a conventional installation because of the fact that a larger number of field-mounted transmitters are used with an accompanying increase in field piping.

One area in which the graphic panel is of great benefit to the mill as compared to conventional instruments is where operator training becomes important. In Fig. 6 we see a

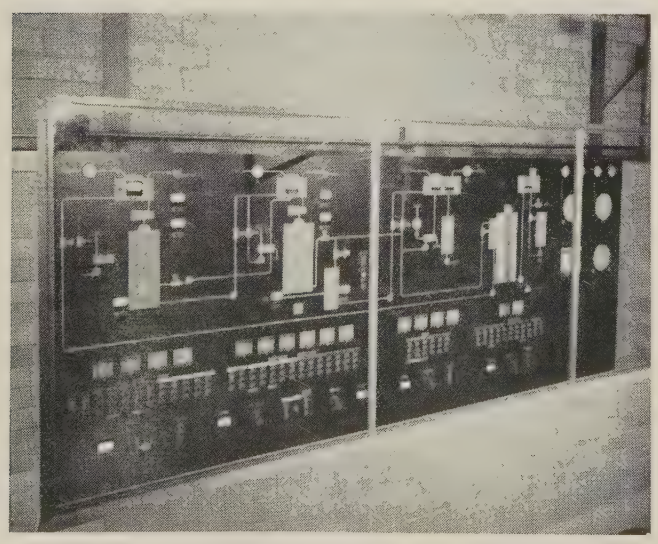


Fig. 6

graphic panel for the control of a bleach plant. This particular mill selected a graphic panel primarily because they felt that one of their greatest handicaps to successful operation would be the lack of experienced operators. The graphic panel was designed with the idea in mind of making operator training as simple as possible. For this reason a black background was used, which is unusual on graphic panels. The plant symbols are light gray and the contrast between the symbols and flow lines and the black background is quite pronounced.

In addition the graphic diagram was made larger than necessary in order to show the operator the process flow in a clear manner.

A semigraphic panel was selected so that the push buttons could be grouped below the graphic diagram. Here again ease of operator training was an important factor. The push buttons are placed from left to right in the sequence in which they should be energized during start-up. The plant is divided into three basic sections for start-up purposes and the nameplates on the push buttons are made in three different colors to relate the push buttons to the sections of the plant. The operator moves from left to right energizing the push buttons in order. As an added aid, a second nameplate is mounted above the first row of nameplates in those cases where it is necessary for the operator to perform some additional function before going on to the next push button.

One operator and helper per shift run this bleach plant; the helper is primarily for liaison between the bleach plant and the rest of the mill. It has been estimated that with the graphic panel, an operator can be trained in one third of the time required if conventional instrumentation were to be used.

Operator training is an important factor whenever a new process is introduced into a mill. Today more and more installations of chlorine dioxide bleaching are being made. When a mill uses chlorine dioxide as a bleaching agent it is necessary for them to generate the chlorine dioxide at the mill site. This involves installing an essentially chemical process and training the operators. Figure 7 shows a graphic panel for the control of a chlorine dioxide generating plant in a large Pennsylvania mill. This panel is of the full graphic type. All control instruments, push buttons, and signal lights are mounted directly in the panel diagram. A master recorder is provided as well as a complete alarm system. Automatic shutdown is accomplished by means of electrical and pneumatic interlocks in case any variable exceeds the safe limit. One operator per shift is used to run this plant. The operation of the mill has been extremely successful and it was found soon after start-up that bleach liquor of a stronger concentration than necessary could be produced. A great deal of

the success of this installation is due to the use of the graphic panel.

There are other applications of graphic panels in pulp mills today. One of these is on the pulp cooking operation in a large southern mill. Other graphic panels are installed on the new-type screw press washers in various mills throughout the country. There are other applications in the design stages today including causticizing and recovery room control, black liquor and sulphite waste liquor evaporation, and paper machine control.

Advantage can be taken of the small space requirements of miniature instruments by substituting these instruments on conventional control panels without using a graphic diagram. Several mills have installed control systems of this type using small consoles. One mill in Virginia uses two consoles for complete control of their four-stage bleach plant. On two relatively small consoles, they have complete instrumentation for the bleach plant as well as electrical controls and interlocks and a recording and alarm section. Space requirements can be reduced to about one quarter of the panel space used by conventional instrumentation.

With these factors in mind it seems plain that when new control installations are planned, serious consideration should be given to the use of miniature instruments and graphic panels.

Measurement and Control of Consistency by the Pressure Drop Method

Cassius S. Conner

During the past few years Taylor Instrument Cos. have conducted a considerable amount of experimental work and have made a number of successful installations of control equipment for regulating stock consistency. We have utilized the common principle that stock fibers moving within confined boundaries exert a friction effect analogous to viscosity changes in the fluid, and that these apparent viscosity effects can be calibrated in terms of consistency. Our findings have indicated that under constant velocity conditions, the pressure drop variations across the metering run of pipe line can be used as a sensitive measure of consistency, and can be correlated very closely to the actual variations in the stock. The simplicity of this method permits the use of standard instrument equipment, and we feel that it is reliable in performance, has a relatively low initial cost, is simple to install and adaptable to existing stock flow circuits. One of the first installations made on this type of measurement was purely experimental and took place at a New York mill on groundwood pulp. The control system consisted of a manometer-type instrument with a segmental orifice as the primary measuring element. This instrument maintained a constant flow through a sample line taken off the main stock line. A second instrument was also a manometer-type instrument with pipe taps into the sample line approximately 48 in. apart. This instrument measured the friction drop across the section of the sample pipe line, and was considered a measure of consistency. This consistency controller throttled a valve in the water supply line to maintain the desired consistency.

We found that if a slight deviation in consistency was detected, the controller responded to bring it back to the control point. The farther the pen was away from the set point, the faster the corrective action of the controller.

From our experience on measuring consistency with this simple method; namely the pressure drop measurement in a sample line off the regular stock line, we felt quite confident that we could recommend such a measuring system which was based on a sound physical principle. We felt, too, that this consistency control system should be used in a continuous process where the pulp is under pressure. A most ideal installation is with the sample line installed as a by-pass between the outlet and suction side of the pump. The dilution water should be added to the suction side of the same pump. By making all the piping as short as possible, time lags can be at a minimum, which is essential to good control.

We have some varied experience with this system, sometimes bordering on the unusual. In one mill we discovered that under certain conditions variations in flow did not affect the pressure drop. When the word "variation" is used, it means those due to slow changes in pump suction head of about 15 to 20% of flow. So the ideal situation for the use of such a measurement would be in large lines of 10 in. or larger, either wood or 18–8 stainless steel; pumped out of large storage chests up to a headbox where there is a constant discharge head, and slight changes in suction head; a velocity of about $4^1/_2$ ft. per sec. A number of such installations are working extremely satisfactorily on the West Coast. Because of the successes we have had with the system in consistency ranging from $^1/_2$ to 4%, we ventured a little further afield, into the realms of consistencies of less than 1%. Through the courtesy of a sulphate mill in Pennsylvania, we were privileged to work with their personnel on a consistency measurement and control problem of 0.8%, using the same pressure drop method.

This system was exactly similar to the first experimental system we put in on stock consistency of 3%. It consisted of a sample line taken off the stock line from the knotter chest, and in this instance it was a $2^1/_2$-in. pipe. Two differential pressure-type instruments were used, one to maintain a constant flow of stock through the sample line, and one to measure the pressure drop. The flow in the $2^1/_2$-in. sample line was measured by means of a segmental orifice plate, and the differential pressure transmitter, with a 100-in. range, transmitted its pressure to a receiver controller which in turn actuated a Saunders valve to keep the flow rate in the sample line under constant value. Any change in flow changed the consistency indication. The consistency measurement, as has been stated, was made by means of another differential pressure transmitter with a range of 50-in. detecting the pressure drop between two taps in a straight line section of the sample line. After some experimentation, a 15-ft. distance between pressure taps was found to be the best location to obtain satisfactory measurement. The receiver controller from this instrument operated a dilution valve which added water to the pump intake so it mixed throughly with the stock.

Both transmitters were continuously purged directly through the meter body. As the pressure drop across the 15-ft. section decreased, a lower consistency was indicated, and the controller closed the dilution valve. The operating consistency of the stock was controlled at 0.85%, and could be changed merely by adjusting the set point on the consistency controller. With the flow at 113 g.p.m. the results of changing the set pointer up and down the scale indicated that for 20% of pen travel a consistency change of 0.6 to 1.4% occurred. This measurement sensitivity is believed to be sufficient for good consistency control.

From the results of this test, and based on a sound principle we feel that we can recommend this system for measurement of low consistency groundwood, sulphite, or sulphate stock, provided the instruments are installed according to our recommendations. This system comes well within the 0.1 of 1% required of most consistency controls.

Automatic Control of Basis Weight Using Radioisotopes

George F. Bearer

There are three basic considerations pertinent to

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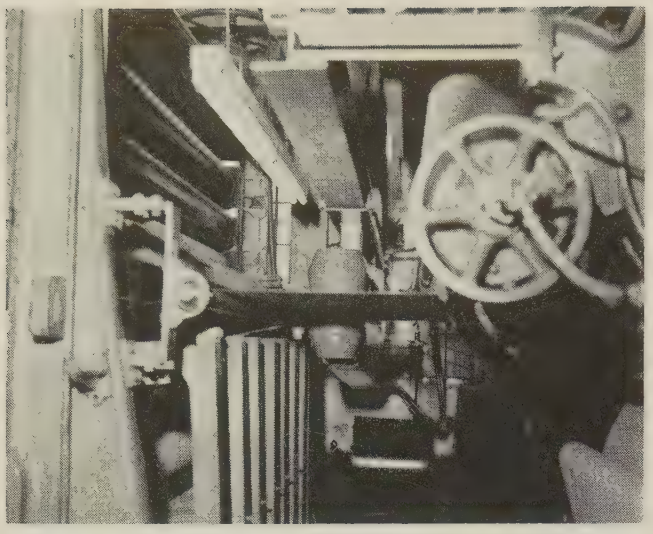

Fig. 1. Transmission measurement with U bracket
Note traversing rail on top of bracket permitting access to machine in case of paper breaks and also addition of idler roll.

automatic control of a paper machine that I would like to discuss.

The first deals with the electronic ways and means of securing accurate control of basis weight. The others are how the equipment is adapted to a machine and the value or results of such control.

In the actual control instrumentation there are four systems involved: (1) the measuring system (2) the scanning system, (3) automatic standardization, and (4) the automatic controller.

The Measuring System

Obviously, the first link in any control mechanism is the measuring system or what we term the sensing element.

Either a transmission or a reflection technique can be employed to measure the sheet. In the transmission unit the beta rays or high-speed electrons emitted from the source pass up through the paper being measured and are collected in a detector or ionization chamber. Once the gage is calibrated a slight difference in the paper weight will allow more or less of these rays to be absorbed and therefore allow a greater or lesser voltage to be developed in the detector. This voltage is then impressed on our measuring circuit, then on to a recorder. Here the weight of the sheet and any deviation from the desired weight is charted with an accuracy of 1%.

The reflection technique is essentially the same as transmission except that the source and the detector are on the same side of the sheet. The paper is usually measured on the last drier or on a surface with a composition different than cellulose. The reason for this is that the measurement depends on a difference in reflection coefficients of two materials.

Much of the accuracy of either of these measuring methods lies in the inherent stability of the radioisotopes used.

The Scanning System

Now that we have a way of measuring basis weight, it is important to place it mechanically where it can do the most good. Because of the characteristic profile variations of paper machines, especially fourdriniers, it seems logical that measuring anything less than the full sheet width would not be satisfactory. The equipment that we utilize to accomplish this is called a two-speed scanner. This scanner moves the measuring head, which is now connected to some kind of a bracket across the sheet. The head moves from the front to the back side at about 2 to 3 f.p.m. and provides an average profile. Then the unit is traversed back to the front side at the fast rate of speed approximately 30 f.p.m. Thus on an average machine you would have a profile every 4 min. At this fast speed the gage integrates or averages the complete sheet weight. Each profile is indexed by this integration. It has been our experience that even though you are averaging machine direction variation while taking these profiles, confusion knowing whether the profile or machine is varying, is rare.

There are several advantages of having such profiling equipment on the machine. One is that the signal we give to the automatic controller is an integration of the full sheet, not a signal from one point or a section of a sheet. We will treat this matter later in this summary. Another advantage in scanning in this manner is that the machine tender is always able to know his profile. When variations occur he is immediately able to make the necessary adjustments and then in a very few minutes see exactly the effect of the changes he has made.

Automatic Standardization

For automatic control to function properly we feel that all the measuring equipment should be automatically monitored to insure accurate functioning. This feature of our equipment we call automatic standardization. At the start of the standardization cycle the gage is brought off-sheet automatically. Then electrically, compensations are made for temperature, humidity, and any component variations (i.e., tubes, resistors) in the measuring system. This cycle is adjustable but usually occurs every half-hour. Normally when these variations are compensated every half-hour, or even at longer intervals of time, the instrument error is negligible. If a part of the circuitry has become faulty to such an extent that standardization cannot compensate for it, the gage will shut itself off, sound a horn, and light a bulb indicating what part of the circuit is not functioning properly.

The Automatic Controller

So here we have an accurate measurement, across the complete width of a machine, standardized automatically. With this system, automatic control of the stock gate is now possible. We feel that anything else falls short of providing optimum control. If the stock is adjusted from one point or from a part of the sheet, you can never be certain whether the correction in stuff is based on a true sheet average or not.

The controller itself provides a proportional correction depending on the rate of basis weight variation. In other words, the greater the variation, the greater the correction.

The equipment has an automatic transportation lag compensator. This is required so that the controller will not

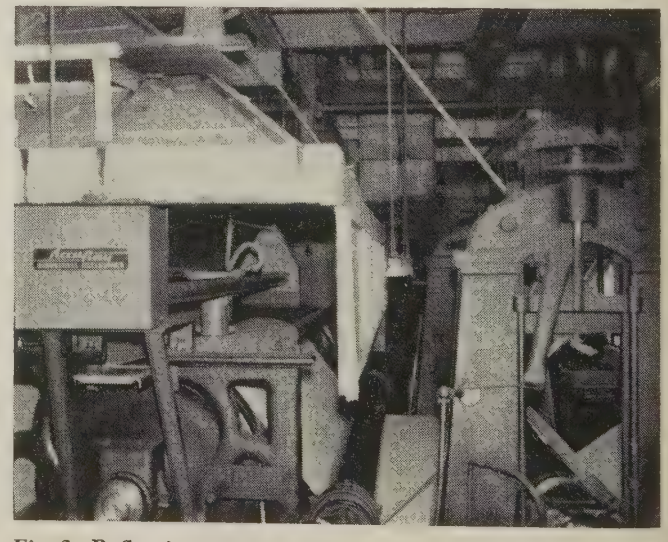

Fig. 2. Reflection measurement with A bracket on last drier. Head moves to plate (bottom, left) for standardization and in case of sheet break

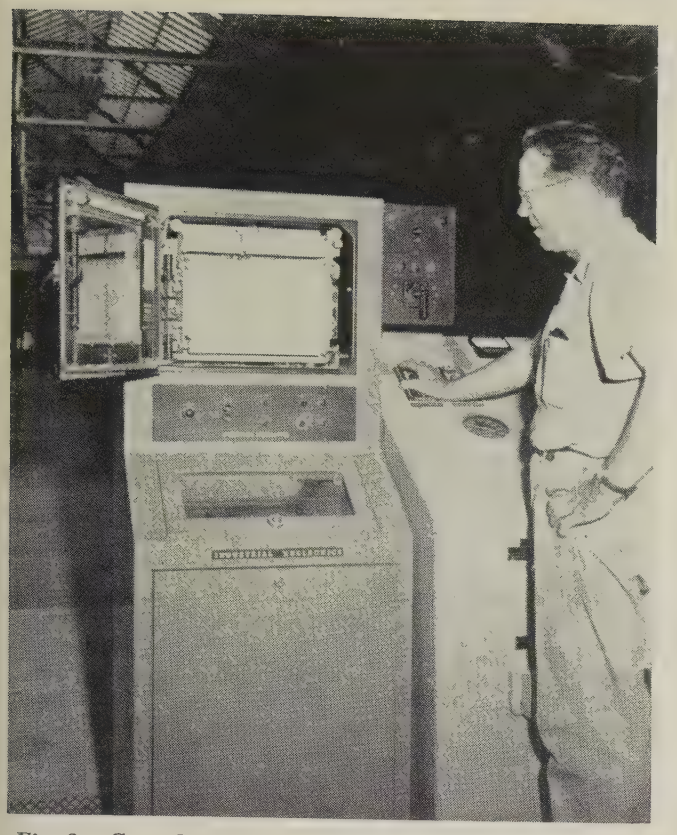

Fig. 3. Console housing recorder and measuring system
Note transfer switch attached to upper right side of console.

cause a hunting action. When a correction is made, no further correction occurs until the gage senses the effect of the change. Then, if the correction taken is not enough because of a continuing weight deviation or slack in the stock gate, another correction is made.

We have discussed the safety or automatic standardization of the gage part of our system already. The controller has its safeties that prevent excessive or faulty adjustment of weight. When one of the safeties employed is activated, the horn referred to before is sounded and is turned off by the machine tender by changing his transfer switch from "automatic" to "manual."

The actual mechanism that adjusts the stock gate depends on the gate itself. A typical installation would consist of a motor and speed reducer linked by a chain to a sprocket replacing the gate hand wheel.

If the stock gate is already motorized, the installation is simpler. Connection can be made from the controller through a relay into the "on-off" switch.

ADAPTATION OF CONTROL EQUIPMENT TO MACHINE

We mentioned before two basic ways of getting our measurement, transmission, and reflection. Whichever system is used is mostly a function of the comparative ease of an individual installation.

Transmission is limited to machine widths of about 140 in. Above this the U bracket needed to scan the sheet becomes too large for the limited space in most mills, because the bracket must traverse off the sheet about 170 in.

Normally a U bracket is installed after the spring roll and before the calender. The passline must be stationary and with a minimum of flutter. Some of our customers have installed idler rolls to provide this constant passline where different calender nips were used.

If a sheet is above 140 in., or is on a fast machine where the addition of an extra roll would be prohibited, the reflection system can be used. This unit which contains the source and detector on one side of the paper is usually installed on the top of the last drier. If the last, or last two driers are sweated, the third from the last drier can be used. This equipment can measure at 3 and 9 o'clock as well as on top.

So that the gage can standardize off-sheet it is sometimes necessary to cut the machine frame on one side. And depending on the gage's position, the felt system may have to be moved.

These installations are shown in the accompanying illustrations.

RESULTS OF AUTOMATIC CONTROL

Very generally, the basic advantages of this system are: (1) improved uniformity and (2) pulp and time savings.

These and other plus values vary with individual companies and machines. Other advantages that our installations have provided are listed below:

1. A help in making faster weight changes.
2. A means to troubleshoot intermittent machine variations.
3. An indication of formation.
4. A permanent record of all your material.
5. Possibility of faster machine speeds.
6. Lowered rejections and off-weight paper.
7. Ability to maintain desired weight when stock is being run out.

Our history of equipment on paper machines, as well as on machines producing rubber plastics, metals, coatings, and other materials, has shown a reduction in weight variation of about one half. This means that if you are producing paper to $\pm 4\%$, our control system should enable you to produce to a $\pm 2\%$. And no matter how old a machine is, or how extensive the short-term variation is, we have found that accurate, continuous control is still effective in reducing weight deviation.

This consistency of uniformity is the first step in obtaining economic return.

Here is an example of savings through reduction of heavy weight paper sold on an area basis.

Let's assume a machine producing 60 tons per day, 6 days per week, at a cost of $100 per ton. A mere 1% savings would mean $18,000 annually. This savings is derived from the elimination of material produced at or exceeding the high tolerance limit. And still the product sold is closer to specification.

If paper is sold on a weight or area basis, a 15-min. daily savings through faster start-ups, weight changes, and perhaps increased machine speed can be considerable. This amount of time saved on a machine with a per ton cost of $50 and a through-put of 100 tons per day, for a 6-day week equals over $55,000.

These savings can have greater significance if the effect on net profit is considered.

This is necessarily a brief treatise on our equipment and the experience we have had. Individual discussion regarding particular aspects of our control system will fill in any gaps in this summary.

O. E. Anderson, Jr., *Publicity Chairman*

December Meeting

The December meeting of the Western District, which was held at the Prospect House, Niagara Falls, N. Y., on December 1, was attended by about 60 persons including a large representation of the management and supervisors of the mills in and near Niagara Falls.

J. J. Forsythe of the International Paper Co., Niagara Falls, presided as chairman and introduced the speaker, R. G. Macdonald, the Secretary-Treasurer of the National Association. Mr. Macdonald's talk follows:

The Services of TAPPI to Pulp and Paper Company Management

R. G. Macdonald

Your chairman, Jim Forsythe, was on the job early in organizing his programs of the Empire State Western District for the current year; so early, in fact, that I advised him that I could not speak at the December, 1953, meeting. He then informed me that his invitation referred to the December, 1954, meeting.

I like to accept one or two invitations such as this one each year since they provide an occasion to say something not only to the group to which I am speaking but to other sections through the medium of the published speech in *Tappi*.

My most recent opportunity to speak at an Empire State district meeting was to the Central District a year ago last May. This meeting, an annual affair, was featured by the presence of the graduating class of the New York State College of Forestry and called for suggestions that would be of value to young men about ready to enter the industry.

This evening, I understand that this meeting of the Western District is favored by the presence of some of the executive leaders of the industry in this famous papermaking region.

In the house organ of the Gould Paper Co., issued this Fall, there was a very interesting account of a tour made by the editor to the sites of a surprisingly large number of pulp and paper mills located in northern and western New York. Your speaker has been around the industry long enough to have known most of these companies. It was therefore somewhat of a shock to realize that the companies in this long list were no longer in business. A tug on the heart must be felt by many of the old-time papermakers who may have been identified with these famous old mills. A man's job, his company, and surroundings become very much a part of him. They are something to which he belongs.

As your operators and managers know, your associates belong to you, their company, and to their surroundings and they belong to him. Sentiments such as these are important, as you know. I receive the house organs of many companies and never cease to be impressed by the fraternal aspects allied with the job of earning our daily bread. It has been truly said that man cannot live by bread alone.

In this area, I know that it is quite possible for you to attend a meeting of some kind every evening in the week. All of these meetings have worth-while objectives. This evening we give attention to the pulp and paper industry and its Technical Association. The Western District provides an opportunity for men in and related to the industry to become better acquainted and to broaden the knowledge of its members in subjects relating to pulp and papermaking. The objective of the National Association is expressed in a few words on its letterhead. It states that the Association is organized for the search and dissemination of knowledge relating to pulp and paper.

To accomplish this objective the Association, which now has about 6500 members, is divided into seven professional divisions and ten Local Sections, including the great Empire State Section with its five regional chapters.

The divisions and their 50 or more committees reflect the active interest of the members. The members came first and the committees and divisions were established one by one to meet a specific demand for special consideration of fields within the scope of the organization.

At present we have very active divisions in the fields of engineering, research, testing, pulp manufacture, paper manufacture, converting, and in special industry interests such as strawboard, structural building boards, water, training, etc.

R. G. Macdonald, Secretary-Treasurer, Technical Association of the Pulp and Paper Industry, New York, N. Y.

All of these divisions function through committees that have, to date, concerned themselves with more than 500 projects. It is the work of many of these committees that eventually filters down to the Local Sections who have the job of interpreting much of this work in terms that are applicable to actual mill operation.

It is the major job of the Technical Association and the staff technical men of the industry to take care of the improvement function of the industry. The Research Development Division of the Association undertakes to express this forward movement in terms of strict technology.

The Fundamental Research Committee continued to make its important impact on the industry when it met in Appleton this Fall to consider "The Principles of the Paper Machine" in one of the most important seminars ever held in this industry. There were no experienced paper machine operators on the program. The speakers, outstanding in their callings, dwelt entirely with the fundamental aspects of the machine—its hydraulics, its filtrations, its clothing demands, heat transfer, drying, pressing, and finishing. There were many well-known and long-experienced papermakers present who were enthusiastic about what they heard even though some of them said that they would look forward to receiving the printed text of the papers and discussions presented so that they could study the very complex data presented, data long needed to explain the operation of the machine, and to establish the direction for further advancement.

A few weeks ago the TAPPI Engineering Division held its ninth annual meeting at Philadelphia. Five hundred and fifty engineers were sent by their companies to attend this meeting, a meeting that is very important since it is devoted to the consideration of engineering problems that the engineers themselves consider to be important. These meetings are prepared a year in advance by our Steam and Power, Electrical Engineering, Industrial Engineering and Materials Handling, Chemical Engineering and Digester Corrosion, Drying and Ventilating, Engineering Research and Machine Design, Mill Maintenance, Hydraulics, Mill Planning, and Engineering Data Sheets Committees.

These are working committees that spend time and a large amount of money in investigating matters that need factual information not presently available. Our Hydraulics Committee, for example, has been watching over a TAPPI financed project at the University of Maine where the flow characteristics of pulps flowing through pipes are being investigated. The results of this study should save the industry thousands of dollars in the selection of pumps and motors. At the TAPPI Annual Meeting a representative of Goulds Pumps, Inc. will reflect the value of some of the information obtained in a paper being prepared utilizing some of the findings of the stock flow project.

The Association's Digester Corrosion Committee has mobilized most of the kraft pulping industry in studying the problem of corrosion in modern digester operation. So much intricate data were obtained that it was necessary to call upon the statistical resources of the Armour Research Foundation to find out what important information was revealed.

The Electrical Engineering Committee has had the cooperation of many companies in its effort to analyze the significance of down-time of paper machines and the factual demands of chippers on motors. To assist the committees in this work, companies have been willing to carry out elaborate tests, many running for months. The information needed could be obtained by no simpler means.

The study of digester corrosion involved experienced statistical analysis to focus attention on the significance of the thousands of tests made. The field of quality control and statistics is relatively new to the paper industry. To meet the needs of the industry to comprehend this important concept the Statistics Committee of the Association has sponored very intensive training courses at the University of Maine

and Western Michigan College during the past three Summers. Other national societies have been conducting similar seminar courses throughout the country. I hope that all of the companies represented here this evening have at least one employee that is competent in the use of this new technical aid.

Since statistical analysis was a natural product of the testing progress of the industry, mention should be made of the work done by the Association over the years in the development of standard testing procedures. The Association was started in 1915 and met most of its early resistance from the management that existed at that time because of its obvious interest in the development of reliable testing methods, a tool that could readily be used by the buyers of paper to establish buying specifications. This fear was realized, and the industry not only survived but is a much better industry, quality-wise, than it was.

The TAPPI Standards stabilized the language of pulp and papermaking. The myriad of papers now being made for uncountable end uses was made possible by the yardsticks created to define properties exactly. Every paper used in commerce has a particular use which may be expressed in terms of strength, color, porosity, smoothness, and 100 or more other defined and measurable properties.

So much for a few examples of the work of some of the Association's committees. For many years they found their objectives satisfied in bringing together and up-to-date the existing knowledge relating to pulp and papermaking. In recent years many of them have found their stride and are devoting more time to the improvement function. When technical men get together it does not take them long to get around to the consideration of the things that they do not know. The reason that such facts are not known to them is that factual information not only does not exist but is unlikely to be made in the ordinary course of events of their day-to-day experience. In a situation like this, an association, such as TAPPI, is fortunate if it is able to finance the break-through into the unknown. It is fortunate also in having the competent services of so many members who are capable of defining these needs and have the capacity, willingness, and authority to direct investigations that will yield much needed information that will establish the foundation for building a better industry.

At present, the Association has more than 50,000 dollars invested in efforts supervised by some of its committees. This program will continue on an even more generous scale as long as the Association has funds available. These hopes depend on the general prosperity of the country, especially the companies that find the *Tappi* magazine to be an effective advertising medium.

The plug referring to *Tappi* as an advertising medium was one of those things that "just came naturally." When the magazine *Tappi* was started in 1949 the Association realized abruptly that it was in another business. It had to learn a new language and conform to many well-established practices known to the publishing and advertising world.

It had to learn how to reveal its innermost facts of life. In doing so it learned much about itself that it had but little occasion to know heretofore. It had to present statistics about its membership in many ways. We know now that about 900 pulp and paper company presidents, vice-presidents, and mill managers are included in its membership as well as about 500 superintendents and production supervisors, and 500 plant engineers to say nothing of its 1500 technical directors and chemists, 300 chemical engineers, and 500 consultants.

This wonderful personnel structure of the Technical Association has grown somewhat like Topsy. Suddenly we realize that TAPPI has reached maturity. At the TAPPI Alkaline Pulping Conference held in Birmingham this Fall, J. W. Warner, president of the Gulf States Paper Co., was the luncheon speaker. He devoted much of his address to the importance of the technical man being understood not only by his fellow engineers and chemists but by the nontechnical executives of their companies as well as the men in the mill who need to know what is going on around them. He ended his interesting and significant talk as follows:

"TAPPI has in the past furnished and is now furnishing many, probably more than its share of good executive timber. The pulp and paper industry looks to TAPPI for even more of such men in the future." He ended his talk with the jingle: "I have six honest TAPPI men (they taught me all I know). Their names are What and Why and When and How and Where and Who."

It was pleasing to hear Mr. Warner say that TAPPI has given so much leadership to the industry. I became aware of the trend during World War II. Advancement to top executive positions by our members started then to move in large numbers. It was not always like this.

The span of experience of your speaker in the industry has paralleled the invasion and upsurge of the technical man. In 1922 there were less than 400 members in the Technical Association. My opportunity to enter the industry at that time was based on the need for supervisors of all kinds. A large number of companies had set up training programs. My two years of so-called apprenticeship consisted of succeeding months of operating beaters, firing boilers, tending grinders, drafting, millwrighting, and third-handing on paper machines.

Like many other graduates of technical colleges, I was a real curiosity to the mill operating men. They could not understand the objectives and were a little bit alarmed by the portent of having college men working alongside of them. Some of the supervisors felt that we were not making a wise choice of occupation. In those days 30 years appeared to be the time required to become a superintendent.

Other technical men were employed to do control work and a few were employed to carry on what was then considered to be research. My second job was with a company that desired to venture into the field of research. The mill was located in Maine and the laboratory was established in Brooklyn to keep it "out of the hair" of the operating staff and under the surveillance of the company executive management. In fact, the immediate liaison between the company executives and the laboratory was the company attorney, a very fine gentleman. The choice must have had some significance. Eventually the laboratory was moved to the mill and is now taken for granted and respected. I still shudder when I recall my visits to the mill and had occasion to explain what I was doing in Brooklyn. There appeared to be but little relationship between what we were doing and the day-to-day operations of the mill. As I look back on those days I realize that the things that we were doing made sense.

Someone in the company had realized that something should be done about the improvement function of the company's operations. One project dealt with prehydrolysis of wood and another gave consideration to ways in which the excess water power available could be utilized profitably. Thirty years later these objectives have been realized. Time was needed to allow the company to catch up with its future.

When I became an employee of the Association in 1927 the technically trained man had not arrived. The height to which he might attain was the chief chemist's job. Very few superintendents, engineers, or executives cared to be members of the Association. It was looked at as an organization of young chemists who still had to demonstrate that they were a consequential part of the industry. I recall very well the desire of a great many of these men to find a job with another company that might prove to be more progressive and appreciative of the value of the technically trained man.

In 1929 the first Local Section of TAPPI was started. In my preliminary contacts with the mill management of the region I found much objection to such an organization and

received a number of promises of noncooperation. This pattern followed in the forming of other Local Sections. Strangely enough, the strongest opposition came from the largest and most successful companies in these regions. Times have changed greatly. The Section most recently organized had the wholehearted blessing and cooperation of all of the management in the region.

The remarks of Mr. Warner at Birmingham remind me that times have changed and explains why TAPPI has grown up. Its members have gravitated or floated into the positions of top management throughout the industry. These men know what TAPPI is, what it is trying to do, and what it can do with management backing it up.

The technical man has reached maturity in time to meet the challenge of the future to management. At the luncheon at the TAPPI Ninth Engineering Conference held in Philadelphia in October, H. W. Prentis, chairman of the board of the Armstrong Cork Co., was the luncheon speaker. His subject was "Industrial Progress of the Future—A Challenge to Management."

Mr. Prentis said: "the manager is the dynamic, life-giving element in every business. Without his leadership the resources of production remain resources and never become production. In a competitive economy above all, the quality and performance of managers determines the success of any business enterprise.

"Today, management is confronted with tremendous technological change. The new technology requires much greater delegation of decision-making authority to the management of small units than was necessary in earlier years. What are the new demands that technological changes are soon to make on management? There are eight in number:

"1. The new technology requires that management has to understand fully what is involved.

"2. The new principles of production demand that management create markets. It can no longer be satisfied with the market as it exists. It must create customers and markets by conscious and systematic work.

"3. The new technology requires a tremendous increase in the number of trained and educated people in business. In the past we have attempted to multiply man's physical strength and skill. We will now have to augment his mind power. The more managerial people that companies possess, the stronger will they be.

"4. The highly trained, highly educated employees of the future will have to work by using their own judgment. They must be led to give their best, voluntarily. They must be managed by objectives and measurements, by persuasion and leadership. The new technology involves new competence, new skill, and a new basic understanding in the management of working people.

"5. Employment will need to be made as stable as possible. It will be too expensive for a company to lose men and women with the skills that they will be required to have.

"6. The new technology will require much longer range planning. It will be necessary to look ahead five years to determine what capital investments will need to be made, what profit margins to seek, how much should be spent for research and development, for market development, for marketing organizations, sales promotion and advertising, how many management people will be needed, where, and with what qualifications.

"7. Manager development for the future is a must. It will need to be directed systematically and consciously at the improvement of performance and ability of the entire manager group.

"8. Finally, it will be necessary to apply much more thoroughly and more consistently the science of management. The new technology makes heightened demands on the social responsibility of management relating to the principles of liberty, not compulsion, reason, not force, leadership by objective goals and not by command or fear, morality, not materialism, religion, not atheism."

The TAPPI engineers at Philadelphia knew what Mr. Prentis meant and expressed themselves accordingly.

It has been a pleasure to talk tonight to the present and future managers of the pulp and paper industry in the Niagara region and elsewhere. If Mr. Prentis' predictions materialize as they very well may, we are going to be busy people dealing with responsibilities that will need the best thinking, not only of the managers of a single company, but the exchange of ideas between the operators of many companies—the kind of discussions that are appropriate to the various meetings of TAPPI. The ways and means of pulp and paper production are destined to be common knowledge. The competition will be in the markets—expanding markets that will need the concerted efforts and brains of the management and its operating and technically trained associates to satisfy.

Many of you, I am sure, have seen reference in the trade press to the Stanford Research Institute Report to the Weyerhaeuser Timber Co. on "America's Demand for Wood, 1929–1975." It predicts a paper and paperboard consumption in the United States of 52.9 million tons by 1975. It is now about 31 million tons annually. United States production of paper and paperboard will be 46.6 million tons, about twice as much as we are making now.

This report reflects the intelligent concern about future markets by the Weyerhaeuser Co., one of the precepts suggested by Mr. Prentis at the TAPPI Engineering Conference.

Paper consumption increased by 93% between 1929 and 1953 (rising from 9.1 to 17.6 million tons). By 1975 it should be about 28 million tons, based on correlation with population, real disposable income, and other trends.

Paperboard consumption has increased from 4.3 million tons in 1929 to 13.8 million tons in 1953. A continued increase is expected but at a lesser rate. For some time this branch of the industry advanced with the increasing use of packaging materials made of paperboard. Although fewer new uses may be found than in the case of paper it is expected that in 1975 the consumption will be about 24.9 million tons.

It is expected that the United States will continue to be a heavy importer of newsprint with new imports reaching about 6.3 million tons in 1975.

The production of paper and paperboard is expected to double, from 24.4 million tons in 1952 to 46.6 million tons by 1975. Some details of these production increases for 1952 to 1975 are predicted as follows: fine paper from 1.3 to 2.3 (million); newsprint from 1.1 to 1.7; book and other printing papers from 3.4 to 6.0; coarse papers from 3.2 to 5.0; and sanitary tissues from 1.9 to 4.0. For containerboard it is 5.8 to 10.7, and boxboards from 5.1 to 10.6. Building papers will increase from 1.3 to 2.7, and building boards from 1.3 to 3.6, all expressed as millions of tons produced per year.

In the case of wood pulp it is predicted that the increase will be from 800,000 tons in 1952 to about 1,800,000 tons by 1975 for use in rayon, acetate, cellophane, lacquers, film, plastics, and explosives.

By 1975 it is estimated that the total consumption of wood pulp in the United States will be about 36.1 million tons, about twice the 18 million tons consumed in 1952.

Little, if any, increase in the expansion of sulphite or soda pulps is foreseen. A steady rise is expected in the production of sulphate and semichemical pulps, sulphate (unbleached) going from 6.3 to 10.0 (million tons and semichemical from 0.8 to 5.2 (million tons). The consumption of groundwood is expected to increase from 2.6 to 5.1 (million tons).

The pulpwood supply in every region is expected to increase. In the east this is expected to be 2.8 million cords and in the west 4.7 million cords. In the south, however, it is expected to amount to 15.5 million cords of roughwood. The use of hardwoods is expected to increase greatly.

These statistics are of interest to all of us and are cited to show that the future looks bright in your industry and mine.

FOURTH CORRUGATED CONTAINERS CONFERENCE

Savannah, Ga., Nov. 17–19, 1954

THE Fourth TAPPI Corrugated Containers Conference was held at The General Oglethorpe Hotel, Wilmington Island, Savannah, Ga., on Nov. 17–19, 1954. Two hundred eighty individuals were registered in attendance. H. T. Scordas of the Union Bag & Paper Corp., Savannah, Ga., was general chairman and John Fuko of The River Raisin Paper Co., Monroe, Mich., was program chairman.

To provide ample opportunity for plant visits on November 18 and 19 the entire technical program was completed during the morning, afternoon, and evening of Wednesday, November 17.

The general theme of the conference was "Corrugated Container Components."

Linerboard

J. J. Koenig of Gaylord Container Corp., St. Louis, Mo., was chairman of the first session which dealt with "Linerboard."

David Wetherhorn of Southern Paperboard Co., Port Wentworth, Ga., read a paper on "The Manufacture of Kraft Linerboard, Including Control Measures," prepared by C. S. Huestis of The Robert Gair Co., New York, N. Y.

G. E. Martin of Fibreboard Products, Inc., Antioch, Calif., discussed "The Manufacture of Jute Liner Board, Including Control Measures."

C. H. Robson and T. H. Larsen of Lanzit Corrugated Box Co., Chicago, Ill., presented a paper on "The Acceptable Linerboard, Its Identification Evaluation from the Converter's Standpoint."

F. C. Came, Union Bag & Paper Corp., Savannah, Ga., gave a lecture, illustrated with a motion picture on "Handling and Storage of Roll Stock."

The speakers on the program, together with the chairman and Milton Yezek of The General Foods Co., Battle Creek, Mich., representing the converters, sat on a panel to discuss the subjects considered in the Linerboard Session.

Corrugating Medium

C. E. Jakeway of The American Box Board Co., Grand Rapids, Mich., presided at the afternoon session to consider corrugating medium.

Clay Richardson of The Mead Corp., Chillicothe, Ohio, presented a paper on "The Manufacture of Corrugating Medium, Including Control Measures."

M. Leon Hamilton of The Container Corp. of America, Chicago, Ill., discussed "The Ideal Corrugating Medium from a Runnability and Quality Standpoint."

"The Adjustment of Starch Adhesive Formulas to Suit Different Types of Corrugating Media and Liners" was discussed by J. E. Killinger of Penick & Ford, Ltd., Cedar Rapids, Iowa.

"Machine adjustments to Suit Different Types of Corrugating Media and Liners when Using Sodium Silicate Adhesives," was the subject of the talk by D. Santmyers, E. I. du Pont de Nemours & Co., Wilmington, Del.

L. K. Burnett of The Ohio Boxboard Co., Rittman, Ohio. presented a paper on "The Evaluation of Components by Ring Stiffness, Concora, or Single Fluter Tests."

The program speakers together with the chairman and E. R. Carpenter of Weston Paper & Manufacturing Co., Terre Haute, Ind., representing the manufacturers, constituted a panel to discuss the subjects considered during the session.

Following a reception and a dinner, presided over by H. T. Scordas, after which the delegates were welcomed to Savannah by G. W. E. Nicholson, vice-president of The Union Bag & Paper Corp., three simultaneous discussion meetings were held.

F. D. Long of the Container Corp. of America, Chicago, Ill., moderated a session on "Moisture in Medium and Linerboards" in the Crystal Room.

Duane Arbuthnot of Fibre Board Container Corp., Richmond, Va., moderated a session on "Checking or Cracking of Outer Liners" in the Whitemarsh Room.

K. R. Martin of Fort Wayne Corrugated Paper Co., Hartford City, Ind., moderated a session on "Finish of Linerboard" in the Wilmington Room.

Plant Visits

On Thursday, November 18, there was a guided tour of the mills and box plant of the Union Bag & Paper Corp. in Savannah and after a barbecue luncheon on the Mary Calder Golf Course of the Company, there was a visit to the operations of The Southern Paperboard Co. in Port Wentworth, Ga.

On Friday, November 19, many of the delegates visited the box plants of The International Paper Co., Georgetown. S. C., The National Container Corp., Jacksonville, Fla., and The Gaylord Container Corp. at Atlanta, Ga.

The papers presented at the conference follow.

The Manufacture of Kraft Linerboard, Including Control Measures

C. S. HUESTIS

WITH a subject as broad as "The Manufacture of Kraft Linerboard, Including Control Measures," there are several possible treatments that could be used. I have prepared this paper with the thought of giving you some of the historical background, the effect that the development of this material has had on the growth of the container industry, and to describe briefly the manufacturing process, including an outline of the control tests made at each stage of the operation.

"Kraft" is a generic term meaning strong; kraft fiber is strong fiber. Kraft linerboard is produced from wood fiber chemically cooked by the sulphate process. It is composed of all virgin pulp and is principally produced on a fourdrinier paper machine.

Although the sulphate process was first used in the Scandinavian countries around 1880, it was not until 1911 that the process was brought to this country. It found its early

C. S. HUESTIS, The Robert Gair Co., New York, N. Y.

principal use in the form of wrapping paper, competing with and supplanting the heavier, weaker sheets made by other pulping processes. As the pulp mills began looking for other markets the board division offered opportunities for use of this material. The first kraft liner made was a cylinder sheet produced around 1922 and the first fourdrinier kraft liner was made in 1927. Since this period kraft linerboard production increased 60,000% and in 30 years has become the largest component in the paperboard field growing from about 20,000 tons in 1925 to roughly 3,500,000 tons in 1953.

The application of the sulphate process to the plentiful supply of southern wood, plus outstanding technological advances which have improved the economics of the industry have resulted in the development of a board admirably suited to meet the growing demand for corrugated boxes. The high strength resulting from this pulping process has enabled the boxmaker to offer to his customers containers light in weight but having those qualities that enable it to withstand, without damage, the shipment of all types of merchandise to every part of the world.

Kraft linerboard mills are principally located in the south. There are two mills in Virginia, two in South Carolina, one in North Carolina, one in Mississippi, three in Louisiana, five in Georgia, and five in Florida.

The manufacture of kraft liner is a papermaking operation complete from the growing and harvesting of the wood through to the shipment of the completed paperboard. Essentially it involves the steps of wood procurement, converting this wood into pulp, the reconversion for re-use of the chemicals used in pulping, and the manufacture of board from the pulp.

Back of every operation must be a volume of timber large enough to supply the mill with its principal raw material. As previously stated, kraft linerboard is made from chipped wood chemically cooked by the sulphate process. Presently, the industry is using all species of southern coniferous wood. We shortly will be producing 5,000,000 tons of kraft linerboard annually. On the basis of growth of a half a cord per acre per year we are cutting and using the growth of 16,000,000 acres a year. There have been many forecasts of demand in the future; a conservative one indicates that by 1975 we will double the tonnage we have today. This would be a most conservative estimate for the kraft linerboard industry, as the indicated increases in population alone would augment demand by 3,500,000 tons and that without any consideration of new use. By this same formula we will be cutting and using the growth of 32,000,000 acres.

Procurement of this amount of wood involves vast operations by the various companies and independent owners of timber lands. In this connection it might be of interest to point out that practically all mills obtain the major portion of their wood from independent owners and farmers. Mills acquire timberlands to supplement their sources of supply. These company-owned lands, although large in the number of acres, are a relatively small proportion of the wood growing land in the south.

The growth of the kraft industry in the south has built up a steadily increasing source of income for the wood producers and has added materially to the development of the economy of the south.

The woods operations have become mechanized to a great extent and the producers have outfitted themselves with equipment such as trucks, tractors, power loaders, and power saws involving the investment of many millions of dollars. Not only are the woodland operators charged with harvesting and supplying present requirements to the mills, but it is their responsibility to supply future demands. To this end they are constantly improving existing lands and developing new areas by proper cutting and thinning, by huge planting programs, fire control, the application of forest genetics, and other scientific forestry practices.

After the wood has been harvested and brought to the mill, it is stored in piles of several thousand cords in order to assure the plant of sufficient reserve for continued operation during periods of wet weather or other emergencies. Mills in the south carry from 10,000 to 80,000 cords in inventory depending on the size of the mill, the season of the year, and availability of the supply.

Starting with the wood supply secured in the wood piles we are now ready to begin the pulping process. In this, the wood is first barked to remove the objectional bark from the log. This bark has no value as a pulping material; it would waste cooking chemical and if allowed to remain would give a dirty sheet full of dark specks. After barking, wood is washed with a spray of water and goes to a chipper where it is reduced to chips of a size that will allow easy penetration of the liquor during the cooking cycle. Here is one of the first control points in the system. The size of chips is carefully controlled and checked every shift as the size is extremely inportant. Lack of uniformity at this point can have decided effect on yield, cleanliness, and to some extent on the physical properties of the pulp. After chipping, the wood now goes to storage and is fed together with cooking liquor to cylindrical pressure vessels known as digesters. Here, by a combination of the amount and strength of the cooking liquor, pressure, temperature, and time, the chips are reduced to kraft pulp. This is the heart of the entire pulping process. By changing any of the above conditions, yield, strength, and other properties of the pulp will be varied. This process is controlled carefully and all modern digesters are completely instrumented and most cook on a predetermined cycle automatically controlled by these instruments. In pulping for linerboard the yield from the wood will vary from mill to mill and will run from a low of about 45% to a high of 60%. Any yield over 52% may be considered as being in the so-called hi-yield class.

In most mills permanganate tests are made of each digester as blown in order to check the degree of cooking, and from these tests the operators make the necessary adjustments to insure a uniform product.

Having pulped the wood to a desired quality, the balance of the pulp mill operations are designed to do two things: to clean the pulp so that it will be fit to make paperboard, and to recover the remaining cooking liquors. The pulp from the digesters is blown to a cylindrical blow tank, capable of holding three to four blows. Here, incidentally, is where the process changes from batch to continuous. Waste vapor is separated from the pulp and used to heat hot water. The pulp goes to washing equipment where it is washed free of liquor. The washing operation is controlled by testing for residual alkali and washing conditions are changed if the end product does not meet prescribed standards. After washing the pulp is diluted and screened to remove foreign matter, such as large particles of bark, knots, and shives. After thickening the screened stock the pulp is ready for the paper mill operation. Control pH tests are run on the deckered stock to measure the degree of cleanliness.

To me, one of the most interesting things about a kraft operation is the chemical recovery system. Here you have a complete chemical plant connected with a paper mill. Only the alkaline processes such as soda and kraft have developed means by which they can recover for re-use a major portion of their chemicals. To give you some idea of the effect chemical recovery has had on the economics of kraft pulping and its importance in the expansion of the container board industry, consider the fact that if we bought all the chemicals used for cooking and wasted the resultant liquors to the sewer, it would take about 1100 lb. of chemical to cook a ton of pulp. Most mills are today operating at under 200 lb. To recover chemicals the black liquor from the washers containing dissolved wood and chemicals is concentrated in evaporators and is then sprayed into a furnace where the combustible material burns off generating steam and the chemicals drop to the bottom of the furnace. This material

is then drawn off as a molten slag, dissolved, and reacted with a solution of hydrated lime to form a mixture of sodium hydroxide and sodium sulphide, the active ingredients in the cooking liquor.

When the dissolved slag from the furnace is reacted with the lime solution a calcium carbonate sludge is formed, this is separated from the so-called white liquor, after which it is concentrated and burned in a kiln to form calcium oxide. This material, when dissolved forms the hydrated lime necessary to react with the product from the furnace, thus the cycle is completed and you have gone through an extremely efficient chemical process where the waste products from the cooking stage are burned to recover heat and chemicals and where the lime sludge from the reaction to make the cooking liquor is reclaimed to make a more useful chemical.

There is a continuous testing and control procedure carried on at each step of the chemical recovery process in order to maintain optimum conditions, high efficiency and to insure a uniform cooking liquor.

The efficiency of the kraft liner process is again demonstrated in the power plant. To make this material requires large quantities of steam and electric power. Of these requirements about 40% of the steam is generated in the chemical recovery process by the burning of black liquor and nearly 20% by burning the bark and sawdust coming from wood preparation. This process requires extremely high quantities of power for process, the highest per ton consumption of any grade of paper or paperboard. Since practically all mills are self-contained you will find that in each mill a major portion of their facilities are given over the generation of power.

When we left the manufacture of kraft pulp the fibers had screened and thickened and were put into storage for paper manufacture. At this point it would be well to explain that on many machines today two stocks are run on the paper machine, a base stock comprising the bottom part of the sheet and formed by the primary slice on the machine and a top liner forming the top part of the sheet and applied with a secondary headbox. The top sheet is normally made from the same stock as the base sheet but screened more finely and refined to a lower freeness.

The first step in the papermaking process is that of refining. The stock is automatically adjusted to the consistency required and is then passed through the refiners until the qualities necessary for the particular sheet being made have been developed. These refiners may be disk refiners, jordans, or a combination of both; apparently equal results can be obtained by any of these methods. After refining, the stock is tested each half hour for uniformity by the permanganate test and for freeness on both the top liner and the base pulp for control of refining.

After being refined to the proper test the stock is ready for the paper machine. The machines that make kraft liner today are one of the mechanical marvels of our industrial era. These paper machines, many of them as much as 20 ft. wide and operated at speeds of nearly a third of a mile a minute, produce paperboard at the rate of hundreds of tons each day, and at the same time are capable of infinite adjustment in order to manufacture the various weights and grades demanded. The stock is diluted and goes to a headbox where it is held at a level sufficient to give hydraulic head enough to force the stock through a slot opening, called a slice, and from there to an endless wire at speed and volume enough to form the sheet required. This is the point where liner is made. Here, by a combination of the excellence of the equipment and the skill of the operators, a sheet capable of meeting the specifications demanded is made. This board must be uniform both across the 20-ft. width as well as in the running direction. The operators, by their knowledge of their craft and by the test data furnished them, make the adjustment necessary to achieve this. To help the operators run the machine, they have available the test data from the refining stage, the dry end tests, and tests that are being run on the headbox for freeness, acidity, and consistency.

Just prior to the paper machine such additive materials as rosin size and alum for waterproofing or resins for some particular quality, such as high wet strength, are put into the stock.

I spoke earlier of the fact that many linerboard machines today have a double headbox to allow a different freeness stock to be used as a top sheet. This box is located about two thirds of the way down the wire at a point where the base sheet is dry enough to receive the flow of the top sheet, but not too dry to give good adhesion.

After the sheet has been formed the papermaking job has been accomplished. The balance of the oparation consists of drying and putting the desired finish on the top side. Drying is accomplished by the method common to all paper machines, that of pressing out as much water as possible and then running the sheet over a series of cans or driers until the desired moisture has been reached. Moisture on the machine is normally controlled by increasing or decreasing the steam to the driers; however, at times it may be necessary to slow down a machine for this purpose. This is particularly true when a machine is operating at close to its maximum drying capacity.

Regarding sheet finishes, most liner machines are equipped with smoothing presses to remove felt marks and smooth the surfaces of the sheet. The rest of the finishing is done in the calender stacks where it may be varied by the amount of pressure and the number of calender rolls used. This is usually determined by practice in the individual mill where experience has taught them how to run their calenders to give a desired result. In addition to the mechanical improvements in finish resulting from smoothing presses and the calender stacks the finish may be varied by surface applications and we have three basic types; a dry finish where there is no liquid application to the surface of the sheet, spray finishes where materials such as water or combinations of water and wax are sprayed onto the sheet just ahead of the calender stacks, and water finishes where materials such as water starch or wax may be applied to the sheet as it passes through the stacks. The choice of these finishes depends to a large measure on the individual requirements of the mills and converters.

As the sheet of kraft linerboard comes from the paper machine it is subjected to a complete testing procedure to check the adherence to set specifications for each grade made. We run the following dry end checks: Each reel is tested for weight per thousand square feet, mositure, bursting strength, caliper, and sizing on the top and bottom sheet by using both the Cobb size test and a dry indicator method for water penetration. In addition to its reel tests, each individual roll is checked for basis weight, moisture, and burst as they come from the rewinder.

To give you some idea of the magnitude and complexity of a kraft liner operation we at Southern Paperboard are at present producing an average of about 570 tons of liner on one machine each day. To do this we consume about 850 cords of wood, over 40 tons of salt cake and better than 10 million gal. of water. We operate a power plant capable of producing enough electrical energy to supply a city of 75,000 people and generate a quantity of steam that would supply some 200 corrugators. We ship about 13,000 rolls a month using some 700 freight cars for this purpose.

To control the process and the material going into it for quality and uniformity, we have a staff of 30 technicians, about 10% of our productive force, who make over 3000 routine tests each day. Of these about 2000 are made in the paper mill, 650 in the pulp mill, and 350 in the power plant and recovery. The operators make additional control tests and some 500 instrument checks.

We also have a staff of five men engaged in research and development problems.

The Manufacture of Jute Linerboard, Including Control Measures

C. E. MARTIN

I THINK you will appreciate that my assigned topic is a broad one, and further that varying degrees of familiarity with the subject are represented in our audience. Accordingly in the time allotted I can only hope to outline the various operations and control tests, endeavoring to make the outline understandable to a large proportion of the audience who are primarily converters, with little experience in board manufacture.

Jute liner has been defined as a liner made on a cylinder paper machine from a combination of virgin pulp (almost always kraft) and waste papers, hereafter referred to as reclaimed fiber. It is not be confused with the fiber obtained from two East Indian plants, which is used in fabrics, cordage, and certain special papers, although the earliest jute liners probably contained a proportion of this jute fiber.

The mill manufacturing jute linerboard is, in general, not integrated with a pulp mill but depends for most of its fibrous raw materials upon an agency which collects, sorts, and classifies used paper and paperboard. Through such groups as the National Association of Waste Material Dealers, Inc., specifications have been set up for the various reclaimed fiber furnishes. There are usually two separate compositions of paper stock (furnishes) used in manufacturing a jute liner: (1) a top liner furnish used on the final cylinder of the paperboard machine and forming the top ply of the jute linerboard and (2) a filler furnish used for all other plies. The top liner furnish is either largely unbleached kraft pulp or reclaimed kraft paper. The filler is typically 100% old corrugated, also called corrugated containers. With the dramatic improvements in cleaning methods for reclaimed fiber that have been developed in the past few years, the use of a single furnish such as 100% corrugated containers for all plies is on the increase.

There are, of course, considerable variations in manufacturing procedures in the industry, many of them designed to handle special local conditions of raw material supply.

Our typical jute linerboard mill has two separate systems for preparing stock for the cylinder machine, a top liner system and a filler system. The top liner system may consist of either slushing beaters or a centrifugal pulper for dispersing the laps of virgin pulp, followed by refiners and/or jordans and a flat, rotary, or centrifugal paper machine screen. Provision for the addition of chemicals such as starches or gums for increased strength development is often made at the machine headbox, just ahead of the machine screen. Rosin size and alum are added either here or back at the slushing beater.

The filler system is the heart of the jute mill. It begins either with a breaker beater or a centrifugal pulper with the trend in recent years toward the latter operating on a continuous basis. Centrifugal pulpers are manufactured in diameters up to 20 ft. with defibering capacities up to 200 tons per day. Bales of paper stock are usually fed in by conveyor. The fiberized stock passes through holes about $^3/_8$ in. in diameter at the bottom of the tub. Rags, string, and wires are pulled out from the center as a crude rope by a "ragger," while most heavy foreign material and floating debris are removed by the "junker," a vertical bucket elevator connected to the bottom of the tube.

The accepted stock from the centrifugal pulper is often defibered further, in preparation for additional cleaning, by some type of disintegrator. The problem here is to defiber the stock completely with as little break-up of dirt particles as possible. Following the disintegrator we might have a high-capacity, high-consistency screen for further removal of light trash such as matches, cellophane, rubber bands, fiber lumps, etc. The accepted stock after dilution, passes through a battery of centrifugal separators (Vortraps, Dirtecs, Hydrafuges, etc.) for removal of small particles of heavy dirt.

Registration desk at the Fourth Corrugated Containers Conference

Next the stock is processed by an asphalt dispersal system, developed through the cooperative research efforts of The Jute Research Group and The Institute of Paper Chemistry and licensed by the Fiber Conservation Corp. Through this process wax and asphalt in the stock are emulsified into extremely small particles dispersed throughout the stock such that unsightly spots do not appear in the finished liner.

After the asphalt dispersal system, the stock is ready for strength development by refiners and jordans. Refining systems must be designed to develop maximum burst, tensile strength, and stiffness at the freeness required for good formation on the cylinder machine, with as little reduction in fiber length and tearing strength as possible. For optimum formation and ply bonding on a cylinder machine a stock with more mechanical treatment is used than that used in making kraft liner on a fourdrinier. From the jordans the filler stock will receive a final cleaning in flat, rotary, or centrifugal machine screens (one for each cylinder vat) before passing to the cylinder machine. As with top liner stock, provision is often made for the addition of chemicals for added strength development at the machine headbox. Size and alum may be added here or at the machine chest.

Jute linerboard is typically made on a seven-cylinder paper machine with one ply of top liner stock and six plies of filler stock. One ply, or web of fiber, is deposited by each cylinder of the machine beginning with the bottom liner ply and finishing with the top liner ply. The various plies depend upon the felting of the fibers under pressure for their adhesion to each other. From the cylinder section the sheet of linerboard passes between heavy rolls under pressure in the wet press section of the machine where the moisture content is reduced to about 65% and is then dried to about 3% moisture by passage over steam heated drier cans. From the driers the sheet winds in and out of two stacks of steel rolls known as the calender stacks. Water is usually applied to the sheet surface on both sides during the calendering operation to give a smooth finish. Surface sizing emulsions, starch and gum solutions for strength improvement, and dyestuff solutions for coloring are other materials sometimes applied at the calenders. The liner from the calenders winds up on a reel from where it is rewound into rolls at 5 to 7% moisture content.

Quality control is a very important function in the modern jute linerboard mill. Routine control testing is used on both product and processing. Instrumentation has been applied

C. E. MARTIN, Fibreboard Products Inc., Antioch, Cailf.

to consistency control throughout the stock preparation system, to refining power measurement and control, to system pH's, and to drier steam pressures for controlling sheet moisture, to name a few. Regular process control tests are often made to check stock freeness at some point ahead of the paper machine. Vat pH is either recorded continuously or checked by control test, particularly when hard sized jute is being made.

Quality control tests are usually made on strips from every reel of the finished linerboard when it is "turned-up" to be rewound into rolls. Among the tests made are basis weight, caliper, moisture content, bursting strength, ring stiffness, tearing strength, puncture, scuff resistance, smoothness, water drop size test, Cobb size test, hot extraction pH, bender test, and test for freedom from odor. For concise explanations of the meanings of these tests I can recommend a booklet entitled "Paper and Paperboard Characteristics, Nomenclature, and Significance of Tests" published by ASTM (*1*). The quality control tests made most often on jute linerboard are those for basis weight, caliper, moisture content, bursting strength ring stiffness, and tear

Basis weight is expressed as the pounds of linerboard per 1000 sq. ft. and control is maintained within ±5% of the desired weight. Basis weight is a vital concern of both seller and buyer since linerboard is bought by the pound and used on an area basis in corrugated manufacture. A guaranteed minimum square footage per ton is usually part of the sales agreement. Considerable progress is being made in the reduction of the basis weight required in jute liner at a given burst test.

Moisture content is expressed as the percentage by weight of the wet weight of the board and is held within ±0.5% at a level in the 5 to 7% range in jute liner as manufactured. Uniformity of moisture content and freedom from wet streaks are very important in subsequent corrugating operations.

Bursting strength, or mullen, is the pounds per square inch of pressure to rupture a circular segment of the liner held in annular clamp. As in the manufacture of other types of paperboard, it is sensitive to variations in furnish composition, stock preparation, formation on the paper machine, basis weight, and calender treatments. It is a strength test requirement for combined board used in containers for railroad shipments as described in the Consolidated Classification Committee Rule 41. Since the bursting strength of combined corrugated board comes almost entirely from its liners, the importance of bursting strength in linerboard manufacture is obvious. Jute liners are manufactured to meet certain burst tests, 65 test, 85 test, 100 test, and 145 tests being the more common ones.

Ring stiffness of paperboard is the edgewise resistance to crushing of a specimen 6 in. long by $^1/_2$ coiled into a ring 2 in. in diameter. The test is usually performed in a small compression tester similar to the ones used for the flat crush test on combined corrugated board. Of all the tests that can be made on linerboard and corrugating medium, ring stiffness, for the present at least, comes closest to measuring that property of liner and medium that influences box compression. Cross-machine direction (cross-grain) ring stiffness relates to top-to-bottom box compression, while machine direction ring stiffness is related to end-to-end compression. Ring stiffness is influenced by the same operating variables as bursting strength and improvement in one property usually means improvement in both.

Tearing strength of linerboard is the work done in tearing a certain predetermined length. As in the case of bursting strength, it is affected by variables throughout the mill system, and the linerboard manufacturer must control these to insure adequate tear for each liner application.

Jute liner has certain characteristic advantages which are worth mentioning; these result primarily from its well-refined furnish and compact cylinder machine formation. Jute liner at a given burst has outstanding ring stiffness which manifests itself in increased box compression strength. It has a lower rate of moisture vapor transmission than more bulky liners and this results in better retention of compression strength in exposure to high humidity conditions. These properties adapt jute linerboard very well to containers for fresh fruits, vegetables, and other perishables where high stacking strength is required, often at very high humidities.

The smooth surface of jute liner is a very desirable one for printing on corrugated cases. In addition, white or colored jute liners can be produced at moderate cost increase by alteration of the top liner furnish to the cylinder machine. Attractive gloss ink print jobs on white or colored liners are being used in increasing amounts as the advertising and sales values of corrugated containers becomes more fully recognized.

I should like to conclude with a few statistics. Per capita consumption of paperboard in the United States in 1953 was 172.5 lb., according to American Paper and Pulp Association figures. An interesting forecast (*2*) by Howard Baumgarten, formerly economist at The Institute of Paper Chemistry, predicts an annual per capita consumption of 400 lb. of paperboard in 25 years. Assuming that, as it was in 1953, about one third of this paperboard will be liners, we will be faced with a demand for almost 10 million tons of linerboard annually by 1979, compared with production of 4,200,000 tons in 1953. This predicted increase, along with similar predicted increases in other grades of paper and paperboard, must be related to our available supply of wood fiber, both new and reclaimed. For one thing, pulpwood yields will have to be increased and for another, the proportion of our total fiber supply from reclaimed fibers will have to be increased.

Both kraft and jute linerboard manufacturers must consider even more seriously in the future the conservation of our resources of wood fiber. In his continued research and progress toward the manufacture of improved linerboard from reused kraft containers and other reclaimed fiber, the jute manufacturer is making a significant contribution to the conservation of our country's resources.

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The Acceptable Linerboard; Its Identification Evaluation from a Converter's Standpoint

C. H. ROBSON and T. H. LARSEN

USUALLY the subject of testing linerboard and setting specifications is either dismissed with a statement of the difficulties involved in an accurate evaluation by any analytical method, or it is made a fetish, requiring multitudinous test results which compounds the mill's problems while solving none of the converter's.

Lack of mutual understanding coupled with inherent obstacles in the analytical evaluation of the relation between cause and effect, result in a rather hazy notion of the significant factors which forecast efficient combining and performance.

A statement of a problem is usually considered an adequate basis for discussion. However, a brief résumé of the conditions which caused attention to be focused on the problem will be helpful in understanding the converter's problems and attitudes.

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We converters have been faced with the situation where more and more customers are demanding that the containers supplied them not only meet the requirements of Rule 41 but also additional requirements, such as: flat crush, compression, etc. This demand has been passed on to the mills and they have done an excellent job of increasing the strength and performance characteristics of linerboard and media. Although the higher strength papers have helped to satisfy customer demands, they have presented, in many instances, difficult converting problems.

With all of this, the container price structure has dropped, competition has become keen, and the converter has been forced to make a basic adjustment in his attitudes and operating philosophy. He has had to develop a philosophy recognizing these conditions: (1) quality as a major concern, and (2) price and service as a determining consideration with respect to the maintenance of customer satisfaction after the prerequisites of quality have been met.

To demonstrate the implications of this philosophy upon the converter, I should like to sketch briefly Lanzit's experiences.

Sales demanded more volume and better quality; subsequently management pointed out that increased volume must be attained while simultaneously realizing a waste reduction and a general increase in operational efficiency, but without sacrificing quality.

In order to satisfy these two prerequisites and maintain our position in a competitive market, we knew it was necessary to increase the efficiency of our operation. Lack of pertinent information with respect to: (1) material flow and scheduling, (2) machine efficiency, and (3) quality acceptance levels, prevented a rationally organized attack upon the problem of identifying production obstacles.

We embarked on a program of improved production control, operator training, machine refurbishing, quality control, etc., but our problem was still unsolved.

Adjusting and controlling the adhesive alleviated the condition somewhat. The information available through the control systems just installed, enabled identification of the machine and materials used on defective production.

Data soon pointed out that certain grades, from certain mills, were the ones most frequently involved in scrap. Investigation revealed that these liners were different—they were not receptive to the adhesive.

Review of the situation brought out the following thinking:

1. The range of the liner qualities from our several sources was too great to be handled with our normal machine adjustments.
2. The liners which were causing us trouble were being run successfully by other converters according to the mill.
3. A mill could not be expected to run a liner for us that was greatly different from normal.
4. The mills should furnish liners which would run well under most conditions.
5. The usual laboratory test meant nothing when related to all liners, but only to a given liner made in a given manner.
6. We knew nothing at all about linerboard.

Discussions with the mills proved very rewarding. They endeavored to make adjustments which would not be too upsetting for them or their other users, but would enable the liner qualities to come within the range of our operating practices.

METHOD OF EVALUATION

A method of evaluation was needed, and lacking correlative laboratory tests, we used the plant as an evaluative instrument. When anything at variance with normal appears, the effect is apparent in changes of the quality and/or production levels.

"Normal" was defined as that condition which permits operating all machines at standard levels of production, scrap and quality, using only the usual machine adjustments.

(Left to right): H. T. Scordas, Union Bag & Paper Corp., Savannah, Ga.; J. J. Koenig, Gaylor Container Corp., St. Louis, Mo.; Burt Mendlin, Cornell Paperboard Products Co., Milwaukee, Wis.; C. H. Robson, Lanzit Corrugated Box Co., Chicago, Ill.; Milton Yezek, Carton and Container Division, General Foods Corp., Battle Creek, Mich.; G. E. Martin, Fibreboard Products, Inc., Antioch, Calif.; David Wetherhorn, Robert Gair Co., Inc., Savannah, Ga.

The machines were adjusted to provide the optimum condition for liner and media from our major sources of supply.

Let me say here, that the medium has an effect of considerable magnitude on liner evaluation. We eliminated the data involving "difficult" media from our study.

This method demands that the converter has: (1) an excellent knowledge of process and its implications. (2) Access to historically and statistically sound data and generalizations about the performance and strength characteristics of raw materials and converted products. (3) A more than conversant understanding of the theories of corrugating, adhesion, and a basic understanding of the abilities and limitations of paper stocks.

SURVEY OF TESTING IN THE INDUSTRY

In order to have estimation of the tests and specifications used by the converter, a questionnaire was designed and distributed throughout the industry.

It was hoped that the questionnaire would furnish information that would be amenable to specific evaluations: (a) tests made on linerboard—(1) type and method of testing, (2) evaluation of test results in terms of performance and runnability, and (b) action taken based on test results.

Unfortunately, inexperience in the use of questionnaires as a research device, prevented full utilization of the replys according to plan. Some of the respondents failed to answer all the questions. However, they did indicate that they made the tests and took action, but showed no specification for the test. Action taken on test results without having at least a rough idea of the desired result seems less than logical. Be that as it may, the questionnaire revealed some very interesting information.

A summary of the replies to the questionnaire is given in Table I, and you may interpret the results as they are convenient and realistic to you. We have attempted to analyze the results of the questionnaire, and have come up with the following comments and generalizations:

It is apparent that testing and evaluation have become an important consideration for almost all converters.

The statistics of the questionnaire indicate this, plus some other ideas which are not too flattering to the converters as a group. In some cases, we have drawn the conclusion that many converters do not know what they are actually testing for and why, and that probably testing is carried on because it has become fashionable.

One of the most significant conclusions which may be drawn from the questionnaire is the number of converters actually performing tests. Seventy-two per cent of the converters answering the questionnaire do have a regular testing

program. Of the total number answering, 73% performed tests in their own plant using their own personnel. Many indicated that they had tests performed by other agencies, such as commercial testing laboratories, or laboratories in other plants to perform tests for them, as well as their own personnel. Although it does not appear on the summary, all of the individuals answering the questionnaire did have access to some testing agency and did have tests performed for them upon occasion.

It is also interesting to note the manner in which the tests are scheduled. Forty-two per cent used a statistical sampling plan, and 22% tested each roll. This indicates the importance placed upon evaluation and testing by converters. Apparently they feel that there is a need which is critical enough to demand scientific and comprehensive evaluation and control.

Most converters (70%) tested incoming rolls. This may be a significant pretesting point, but there may be a seasoning phenomenon which occurs in paper stocks that will change its characteristics.

One of the most significant figures in this section of the questionnaire, is the reply to the number of kraft and jute vendors for the average converter. The indications are that on the average each converter has approximately three kraft vendors and two jute vendors which is a total of five basic suppliers of linerboard. There were several instances where converters had as many as eight or nine basic suppliers of linerboard alone, plus a number of media suppliers. These converters have an excellent opportunity for comparing the performance and runability of linerboard and media. Of course, they also have an opportunity to have an extremely complex and difficult operation.

In general, the first section of the questionnaire is significant with respect to the interest displayed by the converter with problems of tests and evaluation, and that most converters do have an opportunity to compare one liner stock against another.

The second portion of the questionnaire was designed to cover those tests which are performed by the converters and the manner in which they used the results. The response received on this section of the questionnaire indicate that certain tests are performed more frequently than others, but the justification for their use appears to be questionable in some cases. Approximately 90% of the converters perform bursting strength, basis weight, and caliper evaluations, and the majority of them feel that these tests are related to the per-

Table I

Linerboard test	*Check tests used in your plant, %*	*Check tests you believe relate to performance, %*	*Check tests you believe relate to runnability, %*	*(1) Specifications* — *Kraft*	*(1) Specifications* — *Jute*	*Procedure when out of specifications* — *(2) Reject, %*	*(3) Flag, %*	*(4) Adj. mach., %*	*(5) Mod. adhesive, %*
Bursting strenth	97.7	95.3	09.3	94.6 lb.	100.3 lb.	27.9	20.9	14.0	11.6
Basis weight	90.7	48.8	32.6	44.8 lb.	53.2 lb.	09.3	14.0	0.7.	02.3
Caliper	90.7	55.8	48.8	0.0134 in.	0.0138 in.	04.7	16.2	14.0	02.3
Puncture	25.6	55.8	04.7	42.0 lb.	...	...	02.3	...	...
Tear	20.9	34.9	20.9	MD 310 lb. OD 345 lb.	...	...	02.3	...	...
Tensile	...	30.2	09.3	...	...	...	02.3	...	...
Wax pick	04.7	02.3	11.6	24	14	...	...	04.7	...
Moisture content	...	...	...	...	...	...	...	...	...
Crease or fold	14.0	34.9	23.0	...	...	04.7	02.3	09.3	...
Vanceometer	02.3	...	02.3	...	...	...	...	02.3	...
Adhesive	23.0	30.2	32.6	Pull fiber	...	...	...	09.3	07.0
Size	04.7	09.3	16.2	...	...	04.7	04.7	02.3	...
Cobb	09.3	11.6	09.3	0.40 g.—2 min.	...	02.3	...	02.3	...
Rosin	...	...	...	...	...	...	...	...	...
Other	02.3	...	...	...	...	02.3	...	...	...
Water absorbency	25.6	30.2	39.5	...	350 gm. max.	07.0	...	09.3	09.3
Water drop	20.9	07.0	23.0	1/2–1 min.	10 30 min.	02.3	...	02.3	04.7
Surface absorbency of paper to liquids	04.7	07.0	23.0	...	...	...	...	...	04.7
Incline plain water drop	...	02.3	02.3	...	...	...	...	...	...
Butyl carbitol penetration	04.7	02.3	02.3	...	...	...	...	...	...
Flotation (water)	04.7	02.3	...	...	...	...	...	...	...
Flotation (ink)	...	02.3	...	...	...	...	...	...	...
Ink penetration of paper (any type)	...	18.6	18.6	...	...	...	...	02.3	...
Smoothness	23.0	27.9	34.9	Visual	Visual	02.3	...	04.7	02.3
Ring stiffness	53.5	53.5	02.3	MD 85 lb. OD 67 lb.	MD 100 OD 102	...	02.3	...	...
pH	18.6	11.6	11.6	5.5–7.0	...	04.7	...	...	...
Appearance (cleanliness of sheet)	46.5	37.2	07.0	Visual	Visual	07.0	07.0	...	...
Other									
Porisity	02.3	...	02.3	...	...	...	...	02.3	02.3
Brightness	02.3	02.3	...	...	...	...	...	...	...
Flat crush	02.3	...	...	...	...	...	...	...	...
TAPPI—dry. ind.	02.3	...	02.3	...	...	...	...	...	...
Incline plane b.c.	02.3	...	02.3	...	...	...	...	...	...
Slipperiness	04.7	04.7	02.3	...	...	...	...	...	...

Note: (1) Enter specifications for linerboard components, 200 lb. test combined board. (2) Return paper to mill. (3) Flag rolls to indicate special care when processing. (4) Adjust machinery, i.e., from wet to dry steam; increase or decrease heat, etc. (5) Mod. adhesive; add penetrants, colloidal agents; Increase solid, etc.

For purposes of the questionnaire, we are defining the term "runability" to indicate the facility with which the linerboard is run on the corrugator, press, etc., and the term "performance" to indicate those tests which are related to actual carton performance, such as compression and drop tests.

1.	Do you have a regular testing program to evaluate liner stock?	Yes, 72%	No, 28%
2.	If you have a testing program for linerboard, who does the testing?		
	Commercial testing laboratory	23%	
	Your own personnel	73%	
	Laboratory in affiliated plant	12%	
	Other (please explain)		
3.	How often do you test your linerboard?		
	Every roll	22%	
	When difficulties develop	16%	
	Under a statistical sampling plan	42%	
	Other (please explain)	17%	
4.	When do you test your linerboard?		
	When received	70%	
	As it does into storage	10%	
	As it comes out of storage	5%	
5.	How many kraft vendors do you have?	3	
	How many jute vendors do you have?	2	

formance of the finished product. They also indicate that these tests are related to the runnability of the board; from our point of view this is doubtful because we, at Lanzit, have not had any sound indications that these characteristics are related to runnability. On the basis of these test evaluations, approximately 28% of the converters would reject stock because of bursting strength which is below specification. Another 20% indicated that they would flag rolls; another 14% would adjust machinery; another 11% would modify the adhesive. There is little justification for any action but to reject below standard stock. We cannot find any reasonable justification for any other activity in the context of bursting strength evaluation.

There is an almost 50% consensus that basis weight and caliper are related to runability although there is little indication that any corrective measures are taken when these tests fall below specifications.

The following tests are performed in 40% or more of the plants: appearance (cleanliness of the sheet), ring stiffness, and moisture content. It is felt that the moisture content is an extremely important characteristic with respect to runnability, approximately 84% consensus.

In terms of the questionnaire, the following tests are performed the most frequently:

Bursting strength	97%	Water absorbency	45%
Basis weight	90	Smoothness	23
Caliper	90	Puncture	25
Moisture content	53	Tear	20
Ring stiffness	53	Water drop	20
Appearance	46	pH	18

Of these tests, it is felt that bursting strength, basis weight, caliper, puncture, ring stiffness, moisture content, crease or fold, and appearance, in general are related to performance, while moisture content, water absorbency, smoothness, and caliper are related to runability.

In most instances, there are very few rejections made on the basis of these tests. The only two which seem significant are bursting strength and moisture content. With respect to adjusting machinery or modifying adhesive, we find that again moisture content and bursting strength, plus caliper, are apparently the most significant.

It is startling to consider the number and diversity of tests which are performed. On the basis of sheer number, there may be an indication of the kind of interest displayed by the converter. He is definitely interested in pretesting and is making an effort to find the constructive and revealing test. The rather tentative quality of his exploration and discovery is borne out by the small number of converters who are willing to set specifications, and to reject raw stock on the basis of these specifications.

Only 27% of the total number answering stated that they would reject on bursting strength which is below specifications, although the specification for bursting strength on kraft and jute is an average, and it is very close to the requirements of Rule 41.

There were several responses to the problem of rejecting raw stock that were structured in terms of "Are you kidding?" It would appear that the converter is not going to reject unless he is forced to do so. This is as it should be, if we are uncertain we must accept the consequences.

RECOMMENDATIONS

The experience gained from the examination of the area of linerboard evaluation has left us with a series of impressions and has opened up several possibilities for further development and research.

Our initial step in this investigation was to consult various members of the corrugating and its related service industries. This was done to present us with some estimation of the progress and development existent in the area, and to indicate in which direction we should pursue our investigations. It was immediately apparent that the bulk of testing and evaluation had been developed in terms of the performance and strength characteristics of linerboard and converted products. This area has been well developed for many years and is contributing effectively to the fund of knowledge surrounding corrugated materials. There was little information available about the area of pretesting in terms of runnability and performance. If there is any information available in this area, it is not easily accessible to the average converter. One significant factor was outstanding. The average converter and the so-called experts did not have at their disposal methods of evaluation which were amenable to impartial and objective coinage. Each individual has his own method of evaluation based upon an intuition that had been developed over long years of manufacturing and service experience. This kind of situation tends to reduce the opportunity for effective rapport between the various members of the industry, and possibly which is more important, limits the converter's ability to make his needs explicit when discussing his problems with the mills.

Another series of problems which became apparent after a short time was: the manner of testing; how should the tests be performed; when should they be performed; and the real joker was, what do the tests mean: that is, how are they to be interpreted. We considered these problems and discovered that we had been solving actual operating problems for a long time, both with and without the use of testing. The question came to our minds: "How did we actually solve these problems?" We found that we were able to solve problems and identify sources of error with much greater facility than in the past year or two. We now had more information available than in the past. The method of operational evaluation is an outgrowth of this experience.

Probably the most significant idea which has evolved from this experience is that linerboard, adhesive, media, machinery, and other related factors of corrugated manufacturing cannot be evaluated uniquely, but must be considered in relation to the whole process and the ultimate performance of the product from the point of view of our customers.

We feel that there is a basic unity of the principles and theories which comprise this body of knowledge surrounding the corrugated industry, which must be drawn out into a structure and related to theory of operation and evaluation. It must be admitted that this kind of an ideal is futuristic and visionary at this point, but it is imperative that it be an end in view, or we will each be forced to explore only one small corner of the universe in which we are existing.

In terms of the present, there are several positive and effective steps which may be taken under the aegis of a professional organization, such as TAPPI represents. We have explored the implications of linerboard evaluation and find that there is little which may be positively stated about those characteristics which are desirable with the exception of those covered by Rule 41, which cannot be ignored, and possibly moisture content and size. We, as converters, must admit that the paper manufacturer has done an outstanding job of supplying an industry which is not certain and does not know what it wants and needs.

Since the converter has become the focus of an organized critique of his product, he is faced with the rather formidable problem of finding something out about the materials which he is converting. It is to his behest to learn about them since the mills cannot have the same insight into his processes that he possesses. The mills make paper and as such are experts in their own area, which is extremely large and complex. The converter processes liner and media via an operation which is relatively complex and which is dependent upon organizational, technical, and economic considerations.

Linerboard evaluation cannot be carried on alone. It must be related to the whole area of operational and technical

evaluation. Each process, factor or production, and organizational structure must be considered.

It is suggested that a unified committee for evaluation be devised under TAPPI, which would examine and evaluate linerboard and media. The aim of this proposed committee would be to structure and devise pretests which may be correlated to operation, and to attempt to describe those characteristics of linerboard and media which define effective raw materials for conversion.

In order for this kind of a project to be worth while and to cover the related fields, representatives from the adhesive manufacturers, linerboard and media suppliers, corrugated machinery manufacturers, and the converting industry should be given the opportunity to pool their insight, experience, and knowledge as members of the committee. Each representative should have sound working knowledge of the abilities and limitations of their fields.

Handling and Storage of Roll Stock

F. C. CAME

This discussion will cover the handling and storage of roll stock. We will start the manufacture of board in the paper mill and follow through the various operations to the corrugator. It is vitally important that the various operations be considered on a consecutive basis, for very often the change of one handling operation has vital effect on several other preceding or subsequent operations.

ROLL HANDLING IN THE PAPER MILL

On the mill floor the roll may be transported with a special straddle truck, or it may be manually rolled using its round characteristic as a wheel. The advantage of the truck is that one man can move the roll in any direction by himself, whereas moving or turning a roll requires two men without some materials handling aid. These special trucks, costing just over $2000 each, may easily eliminate the need of one extra man per shift at an annual cost of around $15,000.

The proper location for weighing, strapping and stenciling must be considered and space provided in the required area. If this is done then enough rolls can be brought to the men so that the proper work loads will result. It is much better to have the rolls waiting for the men than to have the men waiting for the rolls. Most paper mills discharge paper at a level one floor higher than the shipping point. Several methods are used to lower rolls to the next elevation. Elevators, a hatch using an overhead crane and mono-rail, or automatic lowering equipment may be used.

To determine the right method of lowering board, it is necessary to take into account the various operations which must be performed before and after the board is actually lowered to the other elevation. The number of tons to be moved and the rate at which it must be moved all have an effect on the method used for lowering board. The individual roll sizes also make a great difference in the equipment required.

The hatch was a very successful means of lowering board at Union Bag until mill board production was increased to the present level. Before this increase one laborer behind the machine glued the rolls, and lowered them down the hatch. Two men at the bottom then removed the rolls from the hoist, inserted the plugs, and rolled the rolls to the scale. With the increase in production, however, the hoist could no longer keep up. At that time it became economical to install automatic lowerators and thereby decrease the handling costs involved. The lowerator automatically loads itself from the row of rolls sitting on a sloping floor on the upper level.

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Table I. Methods of Lowering Board

	Choice		
	Elevator	*Hatch*	*Lowerator*
General purpose use	1	2	3
Tons per hour	2	3	1
Operating labor	3	2	1
Installed cost	3	1	2
Maintenance cost	3	1	2

These rolls have been weighed, strapped, plugged, and stenciled on the mill floor where all these operations can be better supervised. Also, where one scaleman and scale was previously required for each machine, now two machines are handled through a single scale and scaleman.

When the rolls arrive at the shipping level they are discharged in either of two directions, depending upon their destination. A simple lever at the upper level controls the direction of discharge of the roll.

Table I shows a comparison of three methods of lowering board from one elevation to another. The comparison is made as shown, giving first, second, and third choices on each of five different basic factors. These factors are not all of equal value. Generally speaking, with two level operation as exists in most paper mills, at least one elevator will be required in order to move various materials for maintenance, chemicals, etc. between the two levels. As a result an elevator is almost always available. If the volume of board to be lowered is not too great it may be possible to use this elevator and handle all of the board produced. The elevator, however, is the most expensive method in terms of operating labor and maintenance costs. As the volume of board to be handled increases, a hatch with an overhead hoist may be installed or a lowerator may be installed. The specific choice of equipment will have to be determined at each plant individually based upon the economics involved at that plant.

SHIPPING BOARD ROLLS

Board rolls may be handled and shipped in many ways. Here in Savannah we normally produce liner on one large board machine. Industrial engineering studies indicate that one truck carrying four 60-in. rolls can keep up with this production in transporting board to our box plant. With efficient loading and unloading, only one truck is required and costs are very low. One mill in Florida uses this same technique for longer hauls, using a tractor-trailer and carrying seven rolls per trip.

Because of our location adjacent to the Savannah River, it is possible to ship board to the northern market via water. There is a saving using barge transportation to the New York area over the rail system. Loading is accomplished by the use of large cranes, and unloading in Trenton, New Jersey, or other points is a simple reversal of the loading technique. In addition, another interesting thing to note is that we can deliver rolls to the New York area as quickly by barge as we can by rail. The only real disadvantage to this system is that storage facilities must be available to accumulate board in approximately 1000-ton lots instead of having daily rail shipments of 30 to 35 tons per car.

For many years the traditional method of shipping board rolls has been horizontally by rail. There are many reasons for shipping in this manner since with this type loading it is possible to unload cars to the ground where car height dock is not available. It is also possible to use lift trucks which are needed for other handling jobs in the mill. A plate is used for roll handling to eliminate roll damage by forks. This plate is simply placed over the forks, and slips on and off easily.[*] A newer technique for roll handling and shipping is the vertical handling which has come into being as a result

of the new large capacity roll grab trucks now available, and the fixed position up-enders. Vertical shipping of board rolls offers a number of advantages in the form of increased tonnage per car, decreased damage, elimination of dunnage, etc. In some cases rolls may be loaded directly using the roll grab trucks, or the roll grab trucks may be used as pictured to up-end the rolls and a truck equipped with a flat plate called a cake-knife may be used for the actual loading. The cake-

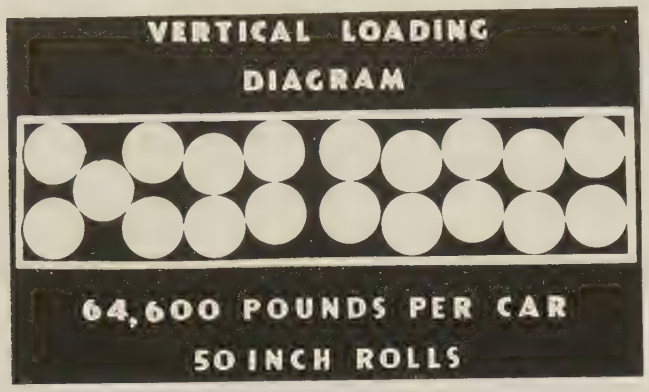

Fig. 1

knife attachment permits the use of a smaller truck in the actual loading operation, but it has the disadvantage of requiring one additional handling with possible damage. Rolls are placed in approximate position in the car, and the next load is then used to push them into final position. Recently a large "Bartel" device was brought on the market which may be used for vertical loading or unloading of board. Obviously, any equipment which will load vertically will also unload. The "Bartel" device consists of a vertical prong which is inserted into the top of the roll and is then pulled back hydraulically so that pressure is exerted between this prong and the back plate of the truck thereby holding the roll against the truck so that it may be lifted and carried. With this device it is possible to store board rolls vertically one or two high in the warehouse.

Figure 1 shows the loading pattern of 50-in. rolls vertically in a 40 ft. 6-in. box car. With this method of loading, 19 rolls may be placed in a car for a total weight of 64,600 lb. Loading these same rolls horizontally, only 17 rolls can be loaded for a total weight of 57,800 lb., or a difference of approximately 7000 lb. per car. The increase in weight per car obviously helps on the loading and unloading platforms of both the mill and the box plant customer. In addition, vertical shipping of rolls decreases damage to the product.

Figure 2 shows the loading pattern of 60-in. diameter rolls where 14 rolls can be loaded to a car for a total of 70,000 lb. per car. Only eleven 60-in. diameter rolls loaded horizontally can be placed in a car for a total of 55,000 lb. per car. Obviously, for vertical roll shipping it is necessary for the mill to have up ending equipment, and it is essential that the plant receiving these rolls have a car floor height dock plus up ending equipment in order to receive these rolls.

Figure 3 shows the storage pattern of 57-in. diameter rolls. Sixteen of these rolls can be loaded per car for a total weight of 72,000 lb. per car. This compares with 13 rolls loaded horizontally for a weight of 58,500 lb. per car. Here at Union Bag, we have changed from 60 to 57-in. diameter rolls for our Chicago box plant. This has been done because of the increased car loading which we can get with 57-in. diameter rolls, particularly in the case of 40 ft. long cars only 9 ft. wide. The fourteen 60-in. diameter rolls shown in Fig. 2 can be placed in a 9 ft. 2-in. wide car but canot be placed in a 9 ft. wide car. Vertical loading of board rolls eliminates most of the damage. It eliminates the use of practically all dunnage in the car thereby decreasing loading costs, and increasing the over-all weight per car. In certain instances, a lower freight rate is available for cars weighing 70,000 lb. or more; and as a result a direct freight saving can be realized by this method of shipping.

STORAGE OF BOARD ROLLS

The storage of board rolls for many years has been horizontal using either overhead grabs or fork lift trucks. The use of overhead grabs allows a large quantity of board to be stored in a given area, but the selectivity which results is very poor. This system works very well if the number of sizes and grades is not too great, and damage with this system is very small. Until recently, this method gave the best utilization possible in square feet per ton of board stored. In the warehouse shown there are 19 rows holding approximately 70 rolls each. Utilization is good, selectivity poor. When the rolls are ready for delivery to the corrugator, they are lowered horizontally to dollies on the floor conveyor. Horizontal storage using lift trucks in some cases gives the best storage utilization and allows the use of fork lift equipment which may well be necessary for other operations. The board may be stored with or without dunnage, although we here feel that the use of dunnage definitely decreases damage and therefore it is used.

A newer method of storage of rolls is vertical storage using either overhead grabs or roll grab trucks. The overhead grab permits enormous selectivity in that each stock of rolls in the warehouse may be a different grade or trim and may be reached without moving any other rolls. The roll grab also permits the picking up of rolls in a horizontal position and the storing in a vertical position. The rolls are rotated for identification and carried horizontally for safety. Delivery of rolls from storage may also be made either vertically or horizontally. Note that the roll after being placed on the floor is given a push to send it to the next operation. Vertical storage using roll grab trucks is the most recent innovation in board roll handling. Equipment recently put on the market permits the storage of 60-in. diameter rolls 72-in. wide to be stored four high to a total of 24 ft. and like the overhead grab rolls may be picked up either horizontally or vertically and stored in a vertical position. Vertical storage of rolls offers excellent space utilization, and at the same time improves selectivity over any type of horizontal roll storage. Vertical storage with roll grab trucks eliminates the need for

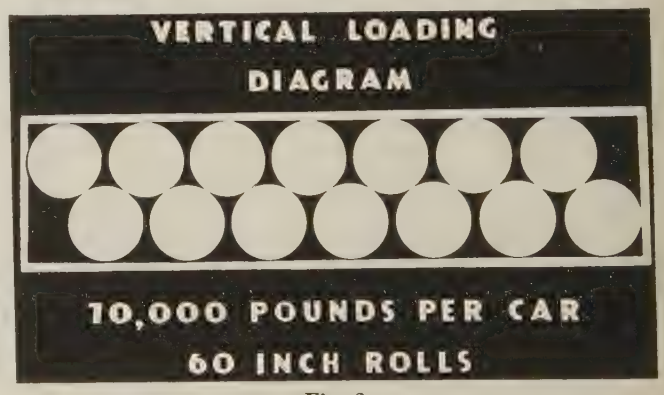

Fig. 2

dunnage, and reduces handling damage to rolls. Rolls are spaced 6 in. apart in one direction for clamp entry and touch in the other direction, thereby wasting a minimum of space. The number of aisles required is a function of selectivity required, and this type of storage can be very flexible.

The type of building required for the storage of rolls vertically with roll grab truck is much less expensive than the type needed for vertical storage with overhead crane, since

the building is needed only for protection from the weather, and does not need to be structurally strong enough to support the crane and roll weight. Also, the overhead space needed for the crane to operate is not required in the case of the truck.

Figure 4 was prepared using 60-in. diameter rolls, 72 in. in trim width. An area of 10,000 sq. ft. was taken and layouts were made for each of the four methods of storage described. We fully realize that the conditions that we used in making this chart do not necessarily represent conditions as they may exist in your many plants, but we feel that the comparative information shown by using this approach is valid.

You will note that we have shown space utilization in square feet per ton for different storage methods under a group of varying building heights. With a building height of 11 ft. it is possible to store rolls 2 high horizontally, nested, or with dunnage use a lift truck and thereby having utilization of 9.8 sq. ft. per ton. Storing rolls vertically with a roll grab only one high can be accomplished with a resultant utilization of 18 sq. ft. per ton. The use of overhead grabs in a low height building is not economical.

It will be noted that in the case of the 15 or 19 ft. of building height horizontal storage of rolls with a lift truck is better than or equal to vertical storage by roll grab truck. With a 23-ft. building height, it is possible to consider the use of horizontal or vertical overhead grabs. The space utilization, however, is very poor with both of these grabs because of the amount of building space which they require across the top of the storage area in order to work. The horizontal roll grab requires 11 ft. 9 in. of vertical storage space, while the vertical grab requires 15 ft. 6 in. We have not shown horizontal storage with lift truck at this height since we do not feel we should go higher than the previous height shown. At 27 ft. the vertical truck again requires the least square feet per ton. This is approximately 4.5 sq. ft. per ton and is four rolls high.

At 31 ft. of building height the vertical truck again shows the best utilization but this is with five rolls high; and while we feel this should be considered, it has not yet been done in any plant to our knowledge. It will be noted that the horizontal grab is the next best utilization at 5.4 sq. ft. per ton. With a 40-ft. high building, the horizontal grab method continues to show the best utilization in square feet per ton. It should be noted, however, that while horizontal method of storage with overhead grab gives the best utilization in these

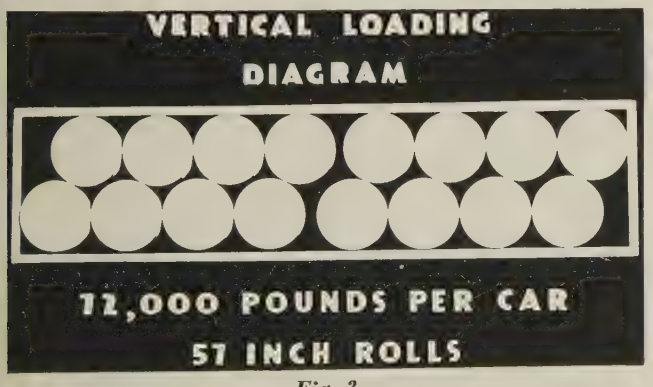

Fig. 3

building heights, the selectivity will be decreasing as the height goes up since fewer sizes of rolls can be held in each stack without being covered by other sizes.

The most interesting point which Fig. 5 shows is that a 27 ft. building height using vertical storage by roll grab truck will give almost the same utilization as a 40 ft. building using overhead grabs. The building required for overhead grab handling must be a great deal higher and also must be constructed so that it is strong enough to hold up the crane in order to equal the same utilization as vertical truck handling at 27 ft. In addition, the cost of the crane and grab must be absorbed. The only real gain that is made for this extra expense is an increase in selectivity. This may be economically feasible for some plants, but, in general, it would appear that a slightly larger building of the less expensive

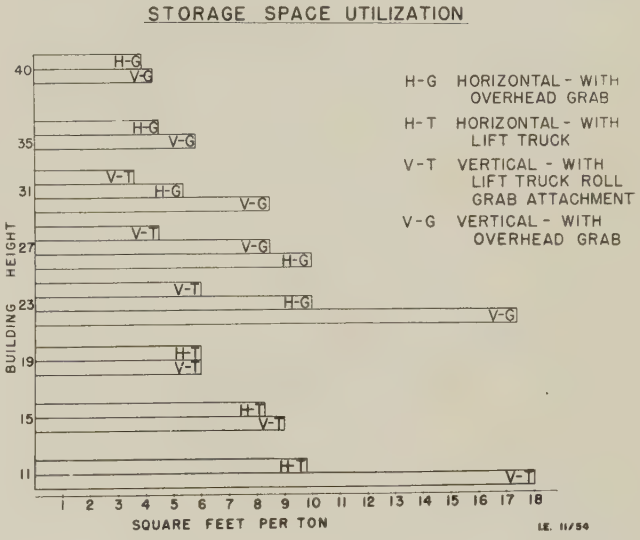

Fig. 4

type would be a better investment and selectivity could thereby be increased by providing more aisle space for use by the truck.

DELIVERY OF ROLLS FROM STORAGE TO CORRUGATOR

Transporting of rolls from storage to the corrugator may be done in several ways. One is the use of the floor conveyor with roll dollies. This method offers a system where a number of rolls may be pushed a long distance using a lift truck, and the rolls can then be handled without other materials handling equipment. It also permits use of a minimum amount of space for turning rolls and putting them in position at the corrugator. The system works very well on rolls up to around 3500 lb. each. Beyond that, rolls are difficult to push and two men are required. The electric straddle truck mentioned earlier may also be used but it will handle only one roll at a time. Now that trucks are being used extensively in the box industry, it is practical to use a cart and track system for roll handling where the carts are loaded by means of lift trucks. This system offers all of the advantages of the floor conveyor system and at the same time permits the use of a larger wheel so that one man may easily handle 5000-lb. rolls. Major disadvantage is the need for materials handling equipment for loading and unloading these dollies. The type of storage used, the location of this storage, the size of roll handled, and the type of roll stands on the corrugator all have a bearing on the method used to transport rolls to the corrugator, and only complete studies at the individual plants will give the answer to the best method to use.

DISCUSSION

Q. (Mr. Martin): (1) Can weatherproof or wet-strength containers and papers, such as resin-treated and sulphur boards, be reclaimed in the jute process? (2) Will a corrugated board having 42-lb. jute liners meet the requirements of Rule 41 (200-lb. test burst class)?

A.: (1) That is a question of degree. It depends on just how water resistant the containers are. We have a laboratory test, using the Waring blendor, where the dispersal time of a sample can be measured; and if the stock disperses within a given time, it indicates that the stock can be pulped in our system. (2) This would depend upon the kind of jute. There is a good deal of work going on to determine the weight and test necessary for

components to meet the 200-lb. combined test. The jute liners in question would have to be special liners to get the combined board test at that liner weight.

Q. (Wetherhorn): What do you consider optimum chip size?

A.: Ninety per cent under $^3/_4$ in. and over $^1/_4$ in.

Q. (Wetherhorn): How much bark is removed per ton?

A.: We use 550 lb. bark per ton.

Q. (Yezek): Is there a relationship between water absorbency characteristics of linerboard and the adhesion value of medium to that linerboard?

A.: We are in process of making tests and we have found that there is a correlation. A number of years ago we ran into problems in warehouses because of slipperiness of box surfaces. The kraft mills went into the question, and it led to a situation where, when we got away from slipperiness, we got a drop-off in water resistance; but we also got a stronger adhesive bond.

Q. (Martin): Will you give some details of the asphalt dispersion system and the name of licensing company?

A.: I can't discuss the details; but the licensing company is the Fibre Conservation Corp., 230 N. Michigan Ave., Chicago 1, Ill.

Q. (Robson): How many converting plants are represented in answers to questionnaire?

A.: Out of 300 to 400 sent out, about 250 replies were received, but a great many replies had to be left out of the summaries. About 100 were represented in the summary.

Q. (Came): What is the capacity of the lowerators? How many pounds, what size, what speed?

A.: We have two. They take rolls up to 120 in. in trim; 8000-lb. capacity. They work at one cycle per minute. It is possible to put in two narrow width or two narrow diameter rolls.

Q. (Martin): What general methods are being used to reduce basis weight of jute liner at a given burst test?

A.: Many methods are used, starting at the beginning of the process: (1) furnish selection, (2) cleaning methods, (3) stock preparation, (4) surface active agents—starches and gums, (5) better formation on the machine, and (6) treatments at the calender stacks.

Q. (Robson and Yezek): Do you know of any method of predicting the case sealing and printing qualities of finished kraft board from tests on the liner before conversion?

A.: (Yezek): In sealing, problems have been encountered on kraft boxes, when the customer's line has been set up for jute. Invariably there is wider penetration on kraft than on jute. Thus, it is believed that the water drop test affects sealing characteristics. (Robson): He did not think water penetration affected the correlation, and he stated that he is using the Vanceometer test in work on this problem.

Q. (Came): What kind of roll grab truck do you use? Make, size, etc.?

A.: Towmotor and Yale trucks are used in Savannah, and Clark in Chicago. Each is a basic 10,000-lb. capacity truck. The roll grab and rotator hold the roll forward some distance from the mast and reduce the effective capacity of the truck to 6000 lb. The Clark truck in Chicago is supplemented with 1000 lb. of additional counterweight because of the higher stacking which it does. The Chicago clamp has a wider range than those in Savannah handling 60-in. diameter rolls down to 12-in. diameter rolls.

Q. (Martin): What is being done to eliminate or control sulphur in roll stock for corrugated to prevent tarnishing of silverware?

A.: Mills are conscious of this and most mills are using control

Airview of Union Bag & Paper Corp.'s Savannah plant. Built in 1936, the plant is now recognized as the largest kraft mill in the world

Seated (left to right): H. T. Scordas, Union Bag & Paper Corp., Savannah, Ga.; Burt Mendlin, Cornell Paperboard Products Co., Milwaukee, Wis.; Milton Yezek, Carton and Container Division, General Foods Corp., Battle Creek, Mich.; G. E. Martin, Fibreboard Products, Inc., Antioch, Calif. Standing: F. C. Came, Union Bag & Paper Corp., Savannah, Ga.; J. J. Koenig, Gaylord Container Corp., St. Louis, Mo.; C. H. Robson, Lanzit Corrugated Box Co., Chicago, Ill.; David Wetherhorn, Robert Gair Co., Inc., Savannah, Ga.

tests. The most common test is putting samples of liner on copper plates and heating.

Q. (Robson): On your sheet entitled "linerboard test" two specifications are unusual in value; namely, ring stiffness for both jute and kraft and puncture on kraft. For jute the CD requirement is higher than MD! Please clarify.

A.: This is merely a summary of the replies and some replies aren't consistent. For instance, one brings up the bursting strength by bringing up the adhesive, which doesn't seem consistent.

Q. (Came): What are requirements for levelness of floor for vertical storage?

A.: All I can say is, if I drive the truck it has to be level.

Q. (Came): What are dangers of knocking vertical stacks down?

A.: They are very stable.

Q. (Wetherhorn): What secondary headbox conditions have to be observed to lay down an even top sheet on liner?

A.: I don't think you can do it only with the secondary—if you have an uneven bottom sheet. That of course would vary from mill to mill. We would normally run 200 pounds less freeness on our top sheet than on the bottom at Southern Paperboard.

Q. (Yezek): Does pressure roll pressure at the single facer have an effect on bursting strength of finished combined corrugated board?

A.: My answer is "Yes." We have found as much as 50-lb. loss in bursting due to excessive pressure. You won't see it, but you can find it out by test. The board will break parallel with the flutes.

Q. (Martin): How fast are cylinder machines operating on 100-lb. test jute?

A.: I know of at least one operating at 500 to 600 f.p.m.

Q. (Came): What is the labor cost relationship between vertical grab and vertical truck handling in a 23 or 27-ft. building?

A.: You have to study conditions in the existing plant. In Chicago (Union Bag) operation, one man empties cars, stores, and delivers rolls to the corrugator. The crane or truck that is idle isn't as expensive as an idle man.

Q. (Wetherhorn): Do you know anything being done to control loose or wavy edges, especially on water finish one side liners?

A.: I haven't the answer.

Q. (Martin): How does moisture vapor transmission rate through the linerboard affect retention of compression strength in a case?

A.: Basically it is a condensation phenomenon. With a case coming out of a frozen storage atmosphere and going into warm, humid air, there is a greater partial pressure of moisture vapor on the outside so that moisture tends to pass to the inside; and as it passes, condensation takes place on the box, its walls, and finally on the inside. As moisture builds up in the wall, compression strength drops. The more rapidly the transfer takes place, the more rapidly is compression lost.

Q. (Wetherhorn): What is being done to control uniform sizing to improve combining operation and sealing of loaded containers on machines such as the Knapp case sealing machine?

A.: We run Cobb size and also TAPPI dry indicator tests.

Q. (Came): Do you use all vertical storage?

A.: No. At Trenton we pile horizontally to 11 ft. and use a truck. At Savannah we pile in one area to three high, and we use other methods. At Chicago we use the high vertical storage, handling with a truck.

Q. (Martin): What is the Jute Research Group?

A.: It consists of about 19 companies working together as a group through individual research contracts with The Institute of Paper Chemistry. It has been operating since 1946, doing fundamental and applied work. Some work is done in the laboratory and some in the mills. The objective is to improve jute liner.

Q. (Weatherhorn): What is being done to control uniformity in color from one run to another, on single or multiple machine operations running linerboard?

A.: We run control tests and compare day-to-day results, and, except for occasional variation, we have had little trouble with color.

Q. (Robson): There are no data given on the summary sheet on moisture content. Is this information available?

A.: Corrected copies will be available for publication.

The Manufacture of Corrugating Medium, Including Control Measures

CLAY RICHARDSON

ANY discussion of this topic that would be reasonably comprehensive could go on for hours, and still touch upon only a few of the many facets of corrugating medium manufacture. It is possible to make a broad general statement that corrugating medium, of a sort, can be made from almost any fibrous material and by any of a number of pulping processes from groundwood to full chemical cooks. We have been asked to talk about our own process, our own problems, and some of the solutions that we have found. While our problems may not be exactly the same, our process represents that of the largest segment of those producing corrugating board. The greatest percentage of the corrugating medium manufactured today is made from hardwoods, and pulped by the neutral sulphite semichemical process. While great progress in the use of continuous digesters has been made during the last 5 to 10 years, the batch process is still used for the greater portion of neutral sulphite pulping, using either stationary or rotary digesters.

Pioneer development of the neutral sulphite semichemical process was carried out at Knoxville, Tenn., by the Southern Extract Co., a Mead Corp. affiliate, and while many refinements have been made, the basic principles of this process remain unchanged. Wood chips are first softened by the chemical action of sodium sulphite. Sodium carbonate or sodium hydroxide is generally used along with the sodium sulphite as a buffering agent to maintain a slightly alkaline condition during the cooking process.

The softened chips from the digesters are defibered, as the second step in the process. Conventional fiberizing procedure involves the use of a disk-type refiner, or attrition mill, either as a single stage or as a series operation.

While we can nominally separate the defibering action of the attrition mills from subsequent refining of the pulp, there is actually a considerable overlapping of the two operations. The proportion of the total work done on the pulp during the defibering stage varies widely from one plant to another, and the refining stage may consist of a single pass through a jordan, or may be expanded to a complex series operation involving the use of a number of types of refiners.

High grade corrugating board is being made on both multicylinder machines and on fourdriniers, but the fourdrinier machine offers the advantage of much higher potential operating speeds. The paper machine is another factor in the manufacture of corrugating medium that we could spend the afternoon talking about, but will have to pass over lightly with only this casual reference to its existence.

I have attempted to describe the framework of the average neutral sulphite process in use today. The operations within The Mead Corp. plants vary somewhat, from mill to mill, within this process framework. I have avoided detail because I want to talk about process control. It is my own opinion that a number of the variations of the neutral sulphite process each represent a good process, and that much remains to be accomplished through a greater degree of control of the process any of us may now be using.

It has been my privilege to be intimately associated with the development of a process control program for The Mead Corp.'s corrugating board plants. We feel that we have made significant progress in process control, but we are not advancing our ideas as representing the ultimate approach. Our goal is uniformly high quality board, and our basic approach is quite simple—start with a uniform raw material and always process it in exactly the same way. The problem only becomes complicated when you try to do it.

Until very recent years papermaking was considered to be an art. It is not an exact science today. One of the major problems in controlling a papermaking process is a human problem, because so may of the important phases of the process depend upon the skill of an operator. These operator skills, acquired through years of experience, cannot be discounted. Our lack of fundamental knowledge is still too great to try to substitute a test and a number on a chart for the ability of a good papermaker. We feel, then, that the proper function of a process control program is to provide a tool, in this case information, which will be of assistance to the skilled papermaker or process operator in helping him to make the proper decisions. This concept of process control represents an integration of automatic control equipment, various laboratory tests, and operator judgment.

We are probably making few, if any, tests that are at all unusual. Most of those that we are making have been made in our mills for years, and were dutifully recorded along with other pertinent operating data. It would be wrong to say that much of this information served no useful control purpose in the past, but maximum benefit was not received. Our company has recognized that if it is worth while to spend the money to make tests and accumulate data, it is also worth while to spend enough more to analyze and correlate these data so that they can be presented in a more useful manner.

We are attempting to control two primary factors relative to board quality. These are potential flat crush and corrugator runability. Each of these primary factors is a function of a great many factors which must be measured and controlled individually. Very few industry-wide specifications have been established for corrugating board. Every step forward toward standardization of properties desired by all corrugating plants will make the papermaker's job easier, because there is still too little agreement among fabricators as to specific properties that are wanted. In making this statement, we recognize that each fabricating plant has its individual problems, just as our various plants have their individual problems within the same corporation, and using the same basic process.

We can predict the flat crush that a corrugating plant should be able to develop from a corrugating medium by using either the I.P.C. single flute tester or the Concora tester. The fabricating operation is so important to flat crush development, however, that it is possible to obtain relatively good flat crush from mediocre medium, or to get poor flat crush from very good medium.

The control of flat crush potential involves the control of almost every step in the entire process. I can enumerate these steps, but the operating ranges and tolerance limits will vary from plant to plant, because of differences in wood species available, and due to equipment differences and major or minor variations from the basic process.

Our control of flat crush starts in the wood yard. Different wood species require some modifications of the processing procedures to produce the same results. Therefore,

CLAY RICHARDSON, The Mead Corp., Chillicothe, Ohio.

some control of the species blending, and reasonable uniformity of wood age and moisture content are desirable.

Cooking control includes control of the weight of wood, on an oven-dry basis, that is loaded into the digesters, control of chip size, control of the ratio of cooking chemicals to wood and of the uniformity of chemical concentration. Time-temperature cooking cycle control is maintained, and routine analysis of blowdown liquors provides a check on cooking uniformity.

Control of defibering and refining consists of freeness tests and, in the case of defibering, a comparison test of the degree of defibering where relative numerical values are assigned for records and future comparison.

Paper machine variables which influence flat crush to the greatest extent appear to be the amount of wet pressing, which influences sheet density and formation characteristics, and the condition of paper machine clothing. There is no one "correct" set of conditions, since these will vary with different equipment and different furnishes.

The control of corrugator runability is almost equally complex, and we do not have any one test to measure this property as we have with predicted flat crush. Experience has shown that certain conditions contribute to good runability, and that others contribute to poor runability. Control, then, means retaining the one set of conditions and avoiding the other.

Initial wood furnish, the manner in which it is cooked, how it is refined and processed, and the way the sheet is formed, contribute strongly to runnability characteristics, and are subject to the same control noted above for flat crush. There are other sheet characteristics that contribute to good corrugator operation and are individually controllable. Wet streaks are a noteworthy source of trouble, and usually are caused by either uneven sheet weight, presses that need repair, driers that are dirty, or worn or dirty felts. Correction of either felt condition, or of the press or drier conditions, is obvious, and uneven weight is usually the result of stock inlet design, slice adjustment, stock consistency, or stock freeness. Since inlet design is a constant for relatively long periods of time, an uneven weight condition that cannot be corrected by slice adjustment can frequently be improved by lowering stock consistency or running to a higher freeness level. Such changes made to improve one condition may have an adverse effect on other sheet properties.

The control of board weight, and here we are not referring to weight variation across the sheet, is essentially the control of the consistency of the stock to the paper machine. For consistency control we depend upon automatic regulators at various points in the system, wherever stock dilution occurs. It appears that the number of consistency regulators in use throughout the system is more important than the type of regulator.

There is considerable lack of agreement among fabricating plants as to the most desirable moisture content for a corrugating medium, and this is often tailored to meet individual customer requirements. Moisture is controlled on the paper machine by automatically varying the pressure in the driers according to the continuously measured variation in moisture content of the finished sheet. Under some conditions moisture is added to the sheet after the drying operation.

Normal caliper range for corrugating medium is 9 to 10 thousandths of an inch. Caliper is a function of sheet weight, furnish and furnish preparation, formation, and degree of pressing. The specific short range control of caliper would be the variation of press pressures or varying the calendering of the dry sheet.

Still another factor influencing runability to some extent is the rate at which the board will absorb moisture. There is some disagreement among users of the board as to whether a high or a low rate is most desirable. This property, too, is largely a function of the wood species used and the stock preparation procedure. A reduction in the amount of refining will usually result in a sheet that is more receptive to moisture.

Building good rolls is a final, and very important step in making a corrugating medium that will run well on the corrugator. Under the best of conditions, these rolls often take quite a beating between paper mill and box plant, and winding good solid rolls, then loading them properly, is not the least important job of the papermaker.

Since the quality of the finished board is a function of nearly every step in the process, an important part of our control program has been to work our way through the process, determining experimentally the effect of variation at each stage, from woodyard to paper machine, on the quality of the finished board. In each instance this involves determining the extent of variation under existing conditions, determining the degree of variation that can be tolerated, and then finding a means of controlling the variation to within acceptable limits. This control may require automatic control equipment, or new production equipment, or revised methods of processing or testing.

The primary reason for making laboratory tests is to provide useful control information, not to provide records. In our programs greatest emphasis is placed on getting all pertinent test results to the operator concerned as promptly as possible. Most data are presented to operators on block charts designed to indicate significant changes and designed to spotlight any abnormal conditions.

In addition to supplying prompt test data to process operators, all of the more important data are posted promptly in a centralized location, so that production supervisors can be kept informed of conditions in all departments without necessarily having to make a trip to those departments. These data are also posted on block charts, and it is frequently possible to tell at a glance where the most probable cause of any abnormal conditions can be found.

Conventional record keeping was revised so as to provide a concise story of the operation for any period of time involved. Formerly we had averages of numerous factors for various times, or, by going back to voluminous records, individual test results were available. Neither of these provided a practical, satisfactory method for maintaining records of operation details. Averages can be deceptive, particularly when longs periods of time are involved. The important factor in regard to abnormal conditions is "how far out of line, and for how long." Some degree of variation in product quality will probably still exist when the perfect process has been developed. Again, the important question is the extent of the variation and the proportion of the total production involved. These answers are provided to process supervisors and to plant management daily, being presented during the first hour of the working day in digest form that can be studied and assimilated in about 1 min. The minimum result is that all concerned are much better informed as to existing conditions, and any deviation from normal conditions. This same information is incorporated into permanent records of a similar type covering longer periods of operation.

It would be nice to report that we have solved all of our problems and reached the goal of minimum variation that has been established, but we are still somewhat in the period of transition from art to science. We are making progress. We are doing this by doing the best job we can with what we know, and by using the tools we now have with which to work. When our system fails, and it sometimes does, we have affectively blanketed the field of factors which we know to influence the process, and have thereby greatly reduced the area of the unknown in which we must seek the answer to the particular problem. In this way we are gradually increasing our fundamental knowledge of the neutral sulphite process, and are gradually bringing about a better degree of control.

Ideal Corrugating Medium from a Runnability and Quality Standpoint

M. LEON HAMILTON

In this paper I will try to outline some of the problems encountered because of variation in the different corrugating media. Unlike some of you corrugated manufacturers, we use a variety of media; we use straw, kraft, and semichemical. If you have other kinds and they are available, we will try them.

I have been in the paper industry for only 15 years, but the transformations that have occurred are great. The liners and media are very much changed as compared to 1940. The methods of combining have changed, and the demand for and work of the technical departments have increased to a more respected position. The liner and media manufacturer has a constant demand for a better product so we can do a better job for our customer and production.

Of these three types of media mentioned, there are many variations, but I hope we can stay with the regular domestic grade of each. The question and "try and answer" period later may get into other types. The comments to follow apply to corrugating media as a whole and not to any one of the three types.

One of the first quality points to consider is caliper. We have a lot of trouble in molding and holding good formation if the caliper runs below 0.008 in. Most of our forming rolls are set for about 0.009 in. and this thickness seems to give us the best formation. Not only does low caliper give us trouble but mediums of high caliper are not easily handled. Calipers of 0.011 in. or higher decapitate, split the side wall, or lean and any one malformation results in the inferior board. Caliper must also be uniform across the machine. The variation across the machine can result in drop outs, cutting at the pressure roll, false bond, and a lot of waste if the operator cannot adjust as fast as these changes occur. Variable caliper also makes roll stock hard to handle and feed evenly into the machine.

If your average caliper is only 0.008 in., this might not seem much, but it is about 12% low. If you have an 8 average, you have some spots down to 6 or $6^1/_2$ and, these places do not form and mold to a perfect flute, and we get unglued flutes at the double backer. These unglued flutes or streaks take their toll on printing quality and compression. You might say that most of your customers are not compression buyers, but believe me, they stack their loaded containers in a warehouse and that which affects compression will affect stacking.

Another quality we like to have uniform is weight. Rule 41 requires a 26-lb. medium, and we like this very evenly distributed over the 1000 sq. ft. Variable caliper is wild formation and again we will have trouble at the combiners and also at the printers. This 26-lb. weight rule is an average and the range is not defined. This is wide open for a machine tender to run as low as 23-lb. on one side and 29-lb. on the other and not have a rejection. Here is another quality that should be controlled in a much smaller high and low range than is done today. Years ago most of the medium was 30, 32, and 34-lb. Today, at 26-lb. I believe we have a much better sheet even though the 30 to 32-lb., gave you more stock on the wire. When old-timers talk about 32-lb. medium the actual weight was nearer 36-lb.

This next test may start a lot of debate, but we have a theory that a uniform bursting strength within 15% limits, is parallel to tensile and gives us a better stock. Tensile is important for controlling warp, feed, and continuous operation. The bursting strength will vary with each type media, but whatever your range, hold it to a narrow range.

A uniform moisture content in a stock can mean the difference between 200 or 500 f.p.m. It is my own opinion that moisture streaks or uneven moisture is our biggest worry. Uneven moisture can affect production, scrap, warp, washboarding, and the operator's disposition. If you mill men make a determined drive to maintain a uniform moisture at $7^1/_2$ to 8% your efforts will pay off. Our corrugators are well equipped to take care of uniform moisture whether it is excessively high or low, but when we get excessively high moisture in streaks, we are in trouble. I have oven-checked moisture on one edge of a 78-in. sheet at 6 and 14% on the other edge. Yes, some of the stock is from our own mills, but we get uneven moisture from all of our suppliers.

Another very important problem caused by excessive moisture in streaks is tight edges or if you move over a few inches, wavy edges. Mention any problem at the single facer and it can be magnified by a tight edge. If this excessive moisture streak is low enough, adjustments can be made to minimize the troubles. If the streak is high, say about 12 or 13%, you can expect very poor quality board and low production. A good papermaker can tell when his machine starts this moisture streak and will make immediate corrections and as a result, we should have a half of a roll of wet streaks instead of the several sets. For the want of a better description, we have an expression of "soggy media." This term we use to describe a media that readily loses its flat crush with very little moisture and temperature increase. When we get this kind of media, combiner adjustments must be made all along the line to maintain good caliper. Other precautions must be taken because it is easy to get washboarding, unglued flutes (which we call high-lows) and also, the off bearers have to crush the edges to hold onto a handful. The printers and the finishers also have trouble with this stock. When we get stock of this type, it does not, as a rule, form up and fluff as it should.

Our laboratories and chart rooms have a test they perform on the media we use. This test is CMT or Concora medium test. This test, on a set of $^1/_2$ by 6-in. strips, with the machine direction and across the machine direction can reveal a great deal about the stock before it goes over the forming rolls. We have found by plotting the CMT value of consecutive rolls, that we can predict the flat crush, the runnability, and how the board will perform in our plant. This CMT does not predict the tight edges, wet streaks, slime or crush spots; only the over-all quality of the media. By the way, this machine can also tell if you are running your corrugator properly. There are definite characteristics of a paper machine that affect CMT and we like to hold the CMT range very narrow.*

It is my impression that most single facers today use starch adhesive. Whether they use starch or silicate, the medium must be receptive to form a fast, permanent bond. With the three types of media, our fraction-of-a-second application and setting presents a big problem. Some work could be done by the manufacturer to bring the different stocks closer together in their characteristics.

In some shipments of medium we experience the adhesive striking through and leaving a sharp point on the forming roll, and splitting the flute formed on the next round. This is much more troublesome with one adhesive than the other. With more uniform formation and a more closed sheet, this is less apt to happen.

As previously mentioned, we use all media and the characteristics of each are well in mind. The operators and crew know what steps must be taken to produce a quality board for the printers; however, with more uniformity in each grade lower limits on caliper, mositure, and weight variation in the stock delivered to the combiners in a roll that can be shafted and run at the speed preferred, will eliminate a lot of our troubles and sell more paper for you.

M. Leon Hamilton, Container Corp. of America, Chicago, Ill.

* *Fiber Containers*, Dec., 1952.

The last few years has been a sellers' market and during this time you have done a remarkable job in lowering the weight per 1000 sq. ft. You have succeeded in raising the flat crush resistance of the media. Your major problem today for domestic containers, which are the great majority of the corrugated business, is to stress uniformity. A 2 or 3-day visit to a corrugator will do more than this paper can emphasize, to bring our problems home to you. If you take our problems seriously, we might conceive a situation wherein we would have only one type of medium in the plants. One medium with closely controlled quality characteristics, as outlined, would relieve a lot of our problems. Your cooperation in the past has been appreciated and the corrugating media of the future will surely be much better than today.

Adjustment of Starch Adhesive Formulas to Suit Different Types of Corrugating Media and Liners

J. E. KILLINGER

BEFORE we can discuss intelligently changes in adhesive formulation to suit different kinds of components, it might be well to very briefly discuss the standard corrugating starch formulation and stress the role of function of the various ingredients contained therein. Corrugating starch adhesive contains two main parts or fractions, neither of which has any real adhesive value until after being heated *in situ*. These fractions are referred to as carrier and raw starch portions. The carrier, as the name implies, represents that portion which prevents the raw or unpasted part from settling out of suspension. It also provides the necessary viscosity to allow for uniform application to the fluted member and, of course, is the source of the necessary bound water to prevent migration of water or drying before the pasting temperature is reached. Two chemicals, borax and caustic soda, are present in nonwaterproof grade of corrugating starch to an extent of about $2^3/_4$ to 3% of the total solids. Caustic soda is employed to reduce the temperature at which starch pastes, thereby permitting bonding at lower board temperatures. It is also effective as a sort of wetting agent or allows for faster penetration of the components. Borax, on the other hand, while it, too, is an alkaline inorganic chemical, does not lower gelatinization temperature of starch but very greatly increases tack and viscosity of the pasted starch. The ratio of borax to caustic is generally 1:1, and if borax be decreased the caustic, due to the common ion effect, ionizes to a greater extent. As a result of the increased hydroxyl ion, the pasting temperature of the starch is lowered. Advantage of varying the ratio of borax to caustic will be discussed for some special adhesives later.

The writer has discussed at previous TAPPI conferences the importance of bound water content of the carrier, how it may be best regulated, and how viscosity may be chemically stabilized. Time will not permit us to discuss this very important part of corrugating starch adhesive preparation, today. However, I do wish you to keep in mind as we progress with the discussion of various modifications of the more or less standard starch formulas that in all modifications we must adhere to formulations which will guarantee fulfillment of the several basic requirements, we must produce conditions which will allow for a sudden and high viscosity level when the board surfaces are heated, we must insure the presence of the necessary amount of water to satisfy the hydrating ability of the raw starch portion, and we must provide conditions which will allow just the right amount of adhesive penetration to insure a good firm bond.

J. E. KILLINGER, Penick & Ford, Ltd., Inc., Cedar Rapids, Iowa

STANDARD MEDIUM TO SLACK-SIZED LINERS AND MEDIUMS

Liners such as kraft or jute from 0.012 to 0.030 in. thickness when combined with the more or less standard corrugating mediums generally run well with any adhesive. When trouble is experienced with such components, the difficulty is usually due to one or more of the following causes:

1. Components too wet or too dry.
2. Improper heat balance on the machine.
3. Misalignment, cross pull, or other mechanical stresses which prevent firm and continuous contact with the adhesive.
4. Moisture saturated or impervious belts.
5. Dirty glue rolls.
6. Improperly prepared adhesive.

It is quite a simple matter to tell by observation if the components are either too wet or too dry. If too wet, more wrap-around on preheaters is indicated, but if this does not correct the difficulty one must apply an excess of adhesive and run at reduced speed to use such components. If the components, particularly the corrugating medium, are too dry, an auxiliary steam shower is often beneficial.

When starch is used as the adhesive and improper heat balance is suspected as the cause for poor bonding, one can quickly check this by observing the dried glue film on the flutes. If it has a whitish or gray color, the raw starch portion of the adhesive has dried before it pasted or gelatinized. If one encounters this condition and a check with pyrometer indicates the plates, rolls, and preheaters are up to temperature, a careful examination will usually reveal the components are not held in contact with each other. When this condition does exist, you will also note very wide or sometimes double glue patterns. If the bond appears to be brittle and snaps when sharply flexed, it sometimes indicates too much heat has been applied and the glue line is actually baked into a horny brittle film. Board which snaps or separates when sharply flexed may not be due to excess heat but insufficient penetration. This will be discussed later under highly sized or filled components. It is quite common to note that a sheet is well bonded over most all of the area but may be loose at either edge. After inspection of the fingers on the single facer indicates this is not the cause of the loose edge, one should look for misalignment, a cross pull by worn ballast rolls on the double backer, or perhaps edge crushing by fowled belts. We have witnessed a substantial amount of difficulty with poor bonding which was caused by the canvas belts which were either rendered impervious to moisture absorption by protective coatings and at one place where the belt, on its return, became saturated by condensate dripping onto its top surface.

It is quite obvious that if the glue rolls or application rolls become encrusted or fowled with debris, no adhesive will be applied to the flutes at such places, thereby putting that much more load on the balance of the glued area. The most common example of this is with gelatinized starch lumps on the fingers at the single facer.

At a meeting of this kind, it is assumed everyone present be familiar with the standard tests which should be made frequently to see if the adhesive be properly prepared. Total solids, viscosity, gelatinization temperatures, and high viscosity of the cooked or pasted adhesive will quickly tell if the base materials from which the batch is prepared and the proper procedure for making up the adhesive have been followed.

HIGHLY SIZED LINERS AND CORRUGATING MEDIA

I believe most operators will agree it is oftentimes more difficult to run at high speeds with any type of adhesive when the components are highly sized with rosin or wet-strength resins. A highly sized, dense sheet will transfer

heat quicker than a sheet of low density, and therefore the difficulty with high speed operation cannot be due to insufficient heat. If the fiber-to-fiber bond is augmented by use of size or resin, then the water drop or size test is increased and this works to a disadvantage to the adhesive for two reasons. First of all, the adhesive does not dewater and penetrate as rapidly as with slack-sized liners of low density and, secondly, the fiber-to-fiber bond is increased by the added size or resin and, while it may require the same or more force to split the board, little or no tearing out of the fibers from the surface is realized. There may also well be other factors which account for the increased difficulty. It does happen, and, regardless of the cause, some remarks with reference to adhesive modifications will be attempted as corrective measures.

An effective corrugating starch adhesive must produce very rapidly an extremely high viscosity and have available sufficient water to develop maximum adhesiveness when pasted. It is also very important that the cooked or pasted adhesive penetrate sufficiently to get sub-surface anchorage. Some students of the mechanism of adhesive bond may well disagree with the above, and perhaps be able to prove, at least mathematically, that adhesion is largely surface phenomenon. Regardless of any such proofs, if we open a dense sheet or change the physical properties of the adhesive to allow for better penetration, we do improve operation. If we keep in mind that the function of the caustic soda is to reduce pasting temperature and, also, act as a wetting agent and that the chief function of the borax is to rapidly and, importantly, quickly increase the viscosity, then we may surmise that if we vary the caustic-borax ratio, an adhesive will result which remains in a more fluid and better state for penetration. Obviously, we cannot go too far in this direction or green or suction bonds will not be sufficiently strong to hold the components together at high speeds. We can have our cake and eat it, too, if we merely delay the rapid rise in viscosity momentarily. This, we feel, may be done by reducing borax content and at the same time increase both the percentage of carrier and total solids.

Special starches are available which when borated do remain more fluid than regular pearl cornstarch.

Wetting agents such as castor oil and other very effective surface-active chemicals may be of some advantage in causing greater adhesive penetration. Our experience has been that a wetting agent is more effective if it be applied to the component surface than if it be used in the adhesive.

The use of elastomers or similar products is also effective as an additive to regular corrugating starch, and this will be discussed later in connection with waterproof adhesives.

Driving moisture of the components to the surfaces which are to be bonded does open and soften dense sheets, and in many cases was all the change needed to get high speeds with dense highly sized components.

Actual prewetting of the components with water or very moist steam will also be effective with hard stock. You may also be interested to learn that when components are prewetted to the most effective level the width of the glue line, particularly at the double backer, is increased. A wide glue line does not necessarily mean a higher adhesive consumption but does improve bonding by simply increasing the area which is pasted.

COATED OR IMPREGNATED CORRUGATING MEDIUM

Under this heading, we refer to corrugating media which have been coated with thermoplastics such as sulphur or resins applied in the molten state. We also include impregnants or coatings which have been applied to a medium at the mill, dried without fluxing, and then melting or fluxing in the corrugating operation. This latter classification represents a type of commercial production in line with a considerable amount of work we have done the past few years. Incidentally, the results look quite promising to produce a medium which will maintain high rigidity at high relative humidities without many of the objectionable features of sulphur. An adhesive for this type of production must possess some properties not necessary for regular board components. The nature of the impregnant will often indicate the best wetting and plasticizing agent. Heat requirements to soften or flux the impregnant usually are higher than necessary with regular components, and as a result of this high heat it is advisable to employ an adhesive which will not flash dry before actual gelatination and penetration be realized.

It is also good practice to run the medium with the treated side on the double backer. Excessive steaming sometimes with an extra steam shower is quite necessary to run this type of component at good speed.

It might also be stated at this time that the patented reacted starch process (*1*) for producing waterproof acid-setting adhesive is quite well suited for bonding sulphur impregnated medium.

The bonding of nonwaterproof sulphur impregnated board may in some cases be improved by using the maximum amount of caustic soda which can be tolerated. An alkaline-setting ketonic resin to the extent of 3 to 5%, based on starch solids, has been employed with good success. Ketonic resins when added to regular borated starch adhesive to the extent of 5% increase the gelatinization temperature 4 or 5°. Because of this, it is expedient to use slightly more caustic when preparing fresh batches containing ketonic resins.

If the real high caustic content adhesive be combined with a 5% ketonic formulation, the viscosity becomes unusually high. Since both types of these formulations have merit for bonding sulphur impregnated board, further work is being done to develop a formula which contains the ketonic resin and the upper limit of caustic soda which may be tolerated.

We might also state here that the viscosity of adhesives to which 5% of ketonic resin is added is not so stable as might be desired. This difficulty, which is more pronounced with all waterproof adhesives, may be improved by following United States patents 2,626,934 (*2*) and 2,650,205 (*3*) for chemically stabilizing viscosity of corrugating starch adhesives.

Perhaps most of you know that a sodium salt of a high titer, fatty acid increases viscosity of all starch solutions which have been pasted. The carrier portion of the corrugating starch adhesive is, of course, pasted and is responsible for the viscosity. We have added a dissolved soap to corrugating starch adhesive which, due to mechanical breakdown, becomes excessively thin bodied. A few tenths of 1% of soap raised the viscosity from 25 to 45 sec. This, therefore, constitutes one other method of controlling viscosity, and the soap or fatty acid derivative is of assistance as a plasticizer with some impregnants.

LIGHT WEIGHT LINERS RUN ON MODERN HIGH TEMPERATURE MACHINES

During the past few years, heavy duty, high temperature machines have become quite common and, while high speed production has been realized, there nevertheless has been some considerable trouble with embrittled glue lines. There are times, due to short sheets and wet liners, when it is not possible to operate these machines at speeds high enough to prevent baking of the adhesive. It is the writer's firm belief that the installation of high temperature equipment without adequate provision to regulate the temperature in the several hot plate sections is very poor practice. In addition to its being of paramount importance to regulate the temperature to best suit both components and speed, it is advisable to vary the temperature of the hot plate sections so as to control curl and warp. On light weight liners, for example, it is often desirable to reduce the steam pressure to very low levels

in the last two sections of plates. An effective reducing valve should be provided for each section.

DOUBLE-WALL BOARD

When double-walled board is glued at the double backer with starch adhesive, it is quite necessary to employ a formulation which will gelatinize at the lowest temperature at which corrugated starch can be stored. With pearl cornstarch, this is about 135 to 137°F. and involves little over 3% of caustic soda. At the double backer, there is very little heat pick-up by the adhesive in the pan, and one may first think the caustic could be increased so as to have a gel temperature below 135°F. An adhesive with an excessively low gel temperature will have comparatively short pot life as it will continue to gelatinize and get heavy with storage even though the temperature in the storage tanks is as low as 85°F. When it becomes necessary to run with these low gel temperatures, one should not prepare more adhesive than will be used in a few hours. I know of no really satisfactory way of adding strong caustic to finished corrugating starch. Atomizing a fine mist of 20 to 30% caustic solution into a tank in which rapid agitation is possible is one way of getting caustic into starch adhesive. However, it does involve a personal hazard to the personnel preparing the adhesive. Some of the newer starch derivatives which develop high viscosity and adhesiveness when pasted do gelatinize in the absence of caustic soda at temperatures quite close to the range exhibited by regular corrugating starch produced from pearl cornstarch. They, like regular starch, may be made to paste at even lower temperatures by the addition of caustic. Starch derivatives of the class may well find application for double-wall board production. These products will also be discussed later under both waterproof and neutral or acid corrugating starch formulations.

Another aid when running double-wall board is to moisten the under side of the double back liner. As this liner passes over the hot plates, steam is generated and helps in heat transfer to the center glue line which is the one most difficult to handle.

On the basis of some preliminary work, I believe there is good possibility of speeding double-wall production with a cooked or pasted starch adhesive. Such an adhesive, if it be formulated properly, need not set completely under the belts but it could make up in the load much the same as with silicate of soda. The type of cooked adhesive which we believe has best chance of solving this problem is not a high concentration of a very tacky and fluid dextrine as might be expected. A more pasty starch or gum which is somewhat buttery and which holds its water of hydration tenaciously is recommended.

LAMINATED CORRUGATING MEDIA

When two corrugating media are glued together and run as a single sheet through the corrugating rolls, one often experiences difficulties, possibly because of the evaporative cooling which occurs in the rolls due to the relatively large volume of adhesive spread over the entire surface of one component. If the adhesive be applied in strips about $^1/_2$-in. wide and in such a manner that a herringbone type of glue pattern be realized, 50% or more of adhesive is eliminated which not only lowers cost but also places that much less load on the corrugating rolls. This may be accomplished very readily by installing a comblike doctor which oscillates with about a 1-in. stroke.

Here, again, with this type of production, one should use starch with a very low gel temperature. We have found the addition of as much as 100% of clay or other suitable filler may be used to increase concentration or to decrease added water economically.

Clay or other suitable fillers also prevent excessive penetration of the carrier portion of starch into very porous media such as straw or bogus. Excessive penetration allows the water-holding portion of the adhesive to leave the surface on which is then deposited raw uncooked starch, and, of course, this results in weak bonding.

NEUTRAL OR ACID STARCH ADHESIVES

Some users of corrugated board for packaging plate glass and other items, whose surface or color might be affected by even low caustic content, specify that the adhesive shall be either neutral or acid in reaction. This, of course, means that neither caustic nor borax may be employed, and in the absence of these chemicals the gelatinization temperature of the starch is high and it does not, when pasted, reach high peak viscosity rapidly. Since borax also increases the viscosity of the carrier portion, its absence from a formulation will necessitate cooking higher percentages of the carrier so as to realize suitable viscosity. In order to compensate to some extent for the elimination of both borax and caustic, it is advisable to increase the solids content, and, instead of operating with the usual 20% solids adhesive, some manufacturers employing this type of adhesive increase the concentration to as much as 30%. Increasing a concentration much above 27 to 30% with pearl cornstarch is not recommended because there is then not sufficient water present to satisfy entirely the hydrating capacity of the starch, and instead of producing a stronger adhesive it is possible to actually produce a weaker one if sufficient water is not present to develop maximum adhesiveness as the starch is pasted. Higher concentrations are possible if one uses a thin boiling type of starch in place of the native pearl corn, because these products are modified by the manufacturer to allow for the production of higher concentration pastes or adhesives. Polyvinyl alcohol might also be used to good effect in acid or neutral corrugating starch adhesives. The use of relatively small percentages of polyvinyl alcohol does show promise for increasing the strength of the green and the permanent bonds. Carriers prepared from starch in the absence of borax also dewater more rapidly, and therefore undesirable excessive penetration of the water-carrying portion of the adhesive can be realized. This is another place where the use of clay or fillers could well be of assistance in not only holding the carrier in the glue line but for increasing solids content of the adhesive.

WATERPROOF ADHESIVES

Waterproof corrugating adhesives of several different types are most always used in conjunction with highly sized, wet strength, or impregnated medium and liners. The running conditions or pasting of such components are therefore subject to the same conditions as previously discussed under highly sized liners combined with nonwaterproof adhesive. Basically, there is in production today possibly no more than three different types or kinds of waterproof corrugating starch adhesive, and there are numerous modifications of the several processes. The older and perhaps most extensively used process is designated as a waterproof adhesive made with an acid condensing resin of the urea formaldehyde type. In order to realize an irreversible or insoluble condition between cooked or gelatinized starch and urea formaldehyde resin, one must have an acid condition, and the higher the acidity the faster the development of water resistance. One cannot, however, employ pH's much below 4.0 to 4.5 because at these more acidic conditions the heat in the corrugator will have a tendency to hydrolyze or liquefy the starch and actually destroy its viscosity and water resistance.

There are two general types of acid waterproof adhesives employed. One, as covered by patent no. 2,450,377 (*1*) involves gelatinizing the carrier in the presence of about 5% of urea formaldehyde resin, this percentage being based on the dry weight of the total starch contained in the adhesive. After the starch and resin have been cooked together to a

temperature of 195°F., sufficient papermakers' alum is added to reduce the pH of the hot solution to a level of 4.5. Very shortly after the alum is added, a pronounced increase in viscosity is realized. In most cases, the adhesive will change from one which flows readily to one which might be described as very glutinous or doughy in consistency. If the temperature be held at or close to 195°F. for a few minutes' time, a reversion takes place and a fluid, long bodied adhesive does result. The bound water content of the adhesive prepared according to this patent is high, and, since no secondary catalyst such as an ammoniacal salt is employed to reduce the pH, it does remain constant throughout the life of the adhesive. Either the single or the double tank procedure may be employed for producing this type of adhesive. However, provision must be made for external cooling by heat exchange in order to reduce the temperature of the carrier, which has been cooked to 195°F., to a safe level for addition to the raw starch portion.

The other acid condensing process involving urea formaldehyde resin consists of preparing the starch carrier in the normal way and adding it to the raw starch suspension, after which the urea formaldehyde resin is added to the cold adhesive and, finally, either alum or ammonium chloride is added as a catalyst. Alum will produce a fixed, nonvarying pH, and the ammonium chloride acts as a catalyst by slowly reacting with the free formaldehyde coming from the urea formaldehyde resin. An end product of this reaction is, of course, hydrochloric acid, and the longer the batch stands in storage and the higher the storage temperature the more acid is produced. It is also to be noted that the secondary or indirect catalyst is really producing the true catalyst at the expense of decomposing some of the urea formaldehyde resin.

Another type of adhesive employed for making waterproof board is the alkaline setting adhesive. Ketonic and modified urea formaldehyde resins condense with starch in the presence of an alkali such as caustic soda. There is presently some difference of opinion today with regard to the advisability of employing borax in alkaline condensing corrugating starch adhesive formulations. We know, for example, in connection with resorcinols when used in a cooked adhesive such as employed for making solid fiberboard and bag pastes, that borax does interfere with development of waterproofing. This quite possibly is because borax reacts with the starch groupings which are also involved in cross-linkage of starch and resins. Both the borax and resins may therefore be competing for the same type of cross-linkage. The alkaline condensing resins, while they do allow for considerably higher speed production, do not produce so strong a tearing bond as is realized with the acid condensing starch-resin formulations. This difference is more pronounced in connection with the single face glue joint. A large amount of work has been done by many investigators in attempting to perfect the acid condensing formulations so that they will be as strong as the acid condensing resins. One somewhat different approach, on which we are presently working and which does seem to have merit, involves a three-way condensation of starch, resin, and polyvinyl alcohol. An alkaline formulation involves the use of polyvinyl alcohol and a ketonic resin with caustic soda being the catalyst, and an acid condensing formulation involves the use of polyvinyl alcohol and a urea formaldehyde resin with an acid catalyst. To date, the indications are that, while the acid condensing formulation with polyvinyl alcohol allows for higher speed production than is possible with straight urea formaldehyde resin, it is not quite so fast as that possible with the use of polyvinyl alcohol and a ketonic resin on the alkaline side. More work is in progress at the present time in connection with this development, and it is our sincere hope that an alkaline condensing corrugating starch formulation may be realized which will allow one to produce waterproof corrugated board at no sacrifice in speed and one which will produce a tearing bond on both faces after soaking in cold water for 24 hr.

LITERATURE CITED

1. United States pat. 2,450,377, "Starch-Resin Reaction Product and Method of Producing Same," assigned to Penick & Ford, Ltd., Inc.
2. United States pat. 2,626,934, "Alkaline-Setting Resin Adhesive and Methods of Making Same," assigned to Penick & Ford, Ltd., Inc.
3. United States pat. 2,650,205, "Alkaline-Setting Resin-Starch Reaction Product and Methods of Preparation Thereof," assigned to Penick & Ford, Ltd., Inc.

Machine Adjustments to Suit Different Types of Corrugating Media and Liners When Using Sodium Silicate Adhesive

D. SANTMYERS

We have learned from the previous papers what are the ideal liners and corrugating media. We have also learned some of the things we should do when these materials are not up to standard. Let us examine now, in more detail, how these materials, be they ideal or substandard, should be handled when using sodium silicate as the adhesive.

The following fundamental principle should be used to determine what machine adjustments should be made to suit different types of media and liners: moisture near the surface of the paper to be bonded produces a wicking action which accelerates penetration of a water bearing adhesive into the paper. This wicking action can be demonstrated by these two cellulose sponges which I have here. This one sponge is dry, and as you can see is quite stiff. This other sponge has been moistened, and as you can see is soft and pliable. By pouring two equal-size pools of this colored water on this glass plate and pressing the two sponges with equal force against the plate, we shall be able to observe the difference in the ability of the two sponges to absorb water. Note that the moistened sponge has done a good job of absorbing substantially all of the water, whereas the dry sponge has left quite a bit of water on the glass plate. Since we started out with pools of equal size and have more water left in the pool touched by the dry sponge, there must have been more water absorbed by the moistened sponge. Wicking action has occurred with the moistened sponge. This sort of thing is actually what occurs when a water bearing adhesive is used to combine paper to make corrugated board, because paper is exactly similar in action to a sponge because they are both made of cellulose.

STANDARD MACHINE CONDITIONS

With this wicking principle in mind and using ideal liners and media, let us set up standard machine conditions for a corrugator, using a sodium silicate adhesive in which the liner boards are threaded over the preheaters to drive the moisture in the paper toward the surface of the paper to be bonded. The paper needs only to be in contact with the preheater for a quarter of a turn to initiate the wicking action of the moisture present to assist the sodium silicate in penetrating the paper. The corrugating medium is also threaded over its conditioner to drive the moisture toward the surface to be bonded; in addition steam is applied at the nip between the paper and the drum so that it can be forced through the medium by the heat of the drum, thereby supplying more moisture for wicking action. The medium is then fed to the corrugator over the conventional steam shower and finally combined with the liner. The moisture present in the

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medium plus that supplied as steam at the conditioner and the shower provides us with the necessary wicking action to enable the silicate to penetrate the corrugating medium to an ideal depth of 0.0010 to 0.0015 in.

Adhesive roll clearances for our standard conditions should be as follows:

A-flute single facer	0.007–0.008 in.
B-flute single facer	0.006–0.007 in.
Double backer	0.009–0.010 in.

Using these adhesive roll clearances, a consumption of sodium silicate adhesive of 14 to 17 lb. per 1000 sq. ft. of A-flute equivalent board can be expected.

Hot plate temperatures for our standard corrugator should be regulated. For a five-bank hot plate section, temperature gradients are suggested as follows:

1st bank	325–350°F.
2nd bank	325–350°F.
3rd bank	275–300°F.
4th bank	225–250°F.
5th bank	175–200°F.

With hot plate temperatures so regulated optimum machine speeds are possible and yet there is little danger of overdrying the board if a somewhat slower machine speed is used.

With the use of sodium silicate under these standard conditions we can expect to achieve firm, smooth, flat board of highest crush and compression strength. Sodium silicate adhesive, with its high solids content (approximately 38%) permits the flutes to retain their shape, resulting in a firm board of increased caliper reading. Dimensional changes are also reduced within the paper as the board is fabricated. This results in a smooth board, free of "washboarding," thereby making possible a better print job. The high solids content of sodium silicate makes control of warp much less of a problem, and the flat board that results is handled much more easily throughout the rest of the box shop. Adhesive costs will be low. Sodium silicate adhesives are currently selling at about 1¢ per lb.; hence corrugating plants located in close proximity to a silicate supplier will have costs of about 14 to 17¢ per 1000 sq. ft., while costs for plants located some distance from the silicate supplier will be slightly higher depending upon how much of a freight cost is involved.

The wicking principle described serves as the basis for the proper use of sodium silicate under a wide variety of operating conditions. Now let us consider how this principle can be used in solving some of the problems that may arise in the use of sodium silicate adhesives.

HANDLING NONABSORBENT LINERS AND CORRUGATING MEDIA

The many advantages of sodium silicate adhesives are well known, but to insure the full benefits from silicate adhesives, correct usage and good operating practices are necessary. With highly sized liners and rigid corrugating media, run on machines equipped with large preheaters and hot plates capable of operating at high steam pressures, improper use of silicate may lead to the problem of silicate dusting. The cause of this silicate dust is that the silicate adhesive has not had sufficient time to penetrate either the liner board or the corrugating medium. Then when the combined board reaches the hot plates, sufficient water is evaporated from that part of the silicate adhesive that has not penetrated the board allowing it to become overdried and flake off as a dust.

If you have such a dust problem, one of the important steps in correcting the difficulty is to adjust the machine conditions to take advantage of the wicking action of the moisture already present in the paper. This can be done by wrapping the liner board around the preheater to drive the moisture toward the surface of the paper to be bonded. Under standard conditions all that is required for average board to condition it properly is a quarter turn on the preheater. For paper low in moisture content, just a "kiss" of the paper on the preheater would be suggested. With a full wrap on modern preheaters it is possible to dry low moisture board completely, which would result in a condition similar to the dry cellulose sponge. For paper high in moisture content, full wrap can be justified to evaporate part of the moisture, but still leave sufficient moisture at the surface of the board to be bonded for adequate wicking action.

Adhesive roll clearance should be reduced to a minimum to help control possible dusting. The suggested clearances are as follows:

A-flute single facer	0.006–0.007 in.
B-flute single facer	0.005–0.006 in.
Double backer	0.008–0.009 in.

Hot plate temperatures should be the same as those for standard conditions.

HANDLING LIGHTWEIGHT LINER BOARDS

With lightweight liner boards, the incorrect usage of sodium silicate may lead occasionally to problems of staining or "bleed-through." Kraft with its long, thirsty, loosely matted fibers, will require closer control than jute, with its short, more tightly woven fibers. However, all types of lightweight liners can give this difficulty under incorrect operating conditions.

If you have a staining problem, one of the important steps in correcting the difficulty is to adjust machine conditions to minimize the wicking action of the moisture already in the paper, because it is this wicking action which in effect draws the silicate all the way through the paper to the outside of the board. By wrapping the liner board around the preheater to drive the moisture away from the surface to be bonded, wicking can be minimized. Here again the amount of wrap should be adjusted for the amount of moisture in the liner. Adhesive roll clearance and hot plate temperatures should be the same as standard.

The temperature of the silicate should also be taken into account if the staining problem is encountered. The viscosity of the sodium silicate varies with temperature: the lower the temperature the higher the viscosity and, conversely, the higher the temperature the lower the viscosity. Lower viscosity silicates will naturally tend to flow more readily than higher viscosity materials, therefore, it is suggested that the temperature of the silicate never be allowed to go above 90°F. at the double backer; a temperature of 70° to 80°F. would be preferred if a silicate staining problem is being encountered.

HANDLING HEAVYWEIGHT LINERS

Heavyweight liners, in particular heavyweight liners with high moisture content, need special attention to achieve optimum results. With such liners it is difficult to operate at high speeds without either loose edges or weak bonds. The loose edges or weak bonds are caused by the wicking action of the high moisture content of the heavyweight liners; in addition to the wicking action there is excess moisture present, sufficient to dilute the silicate to the point that a good bond will not result. By wrapping the liner board around the preheater to drive the moisture away from the surface to be bonded, the wicking action can be minimized. In this case full wrap on the preheaters can be justified to obtain a satisfactory machine speed. Even with a full wrap there is still the possibility that there will be sufficient moisture left to dilute the silicate. To overcome this, the adhesive roll clearances should be increased to apply more silicate. For 0.023 and 0.030-in. liners, adhesive roll clearances of 0.011 to 0.013-in. are suggested. Control of temperature, and therefore viscosity, of the silicate is just as important in handling heavyweight liners as it is in preventing staining, and the same remarks about optimum temperature of silicate apply in both cases. Furthermore, your supplier can recommend the

proper commercial grade of sodium silicate for best operating results under specific conditions.

Hot plate temperatures should be the same as standard unless the moisture content of the paper is extremely high. In this case, the temperatures of all the banks should be raised to 325 to 350°F. in order to be able to operate at higher machine speeds.

The major suppliers of sodium silicate have technical service representatives available to the corrugated box industry for assistance in maintaining maximum performance in the manufacture of corrugated board. These service representatives are thoroughly familiar with the properties of sodium silicate adhesives, the various types of corrugators, and the different types of corrugating media and liners used in manufacturing corrugated boxboard. The services of these technical representatives are offered free of charge, and the sodium silicate adhesive industry welcomes the opportunity to assist the corrugated boxboard industry in the manufacture of the highest quality boxboard at the lowest possible cost.

Evaluation of Corrugating Material by Ring Crush, Concora, and Single Fluter Tests

L. K. BURNETT and R. H. GLASER

THE title is very impressive, but it is slightly misleading. We wish that we were able to present a comprehensive study of this very interesting subject with some broad conclusions. Unfortunately, we cannot do that. We do propose to present certain data from our own limited experience in using these three test methods for evaluating corrugating material.

Our primary interest in the use of such tests is somewhat different than some of the rest of you. We are principally interested in evaluating corrugating material as a user. Many of you are interested in using such a test in connection with your production of corrugating material.

We feel that our data justify certain conclusions for our own use. However, we recognize that the industry has a larger problem, and we present our data with the hope that they will lead to discussions which will benefit all of us by eventually getting a test or tests which provide the best possible evaluation of corrugating material for use in corrugated boxes for all concerned.

Over a number of years we worked out methods for evaluating our corrugating material with ring crush data. We found that these data gave us numerical predictions of both flat crush and top to bottom box compression characteristics of the finished corrugated board. We therefore standardized on this method and are still using it as our standard procedure.

When the single fluter and Concora tests were introduced, we felt that we should evaluate them in comparison to the ring crush method to see whether they would give us better correlation. Some of our suppliers are anxious that we use a method which can also be used by them to control production. We have a great deal of sympathy for this objective, and feel strongly that wherever possible we should be using methods which are usable in production control work.

Therefore, we set up some experiments where we evaluated samples of various corrugating material, including semichemical and straw, by our standard method and also by these two new tests and then compared the results of these tests on the flat material with flat crush and box compression of the finished corrugated board. In these comparisons, we used the same liner so as to eliminate this variable. We made the tests on both B and C-flute board.

Ring crush data were obtained on conditioned $^1/_2$ by 2-in. samples following the methods outlined in TAPPI Standard

Fig. 1

T 472 m-51 and ASTM method D1164–51T. The compression instrument used was a 750-lb. National Forge compression tester equipped with abrasive platens (Fig. 1). The data were collected using a scissors-type holder. However, the results obtained from an island-type holder are comparable (Fig. 2). We prefer the scissors type because of the larger number of samples we can run in a given time. We use a standard tensile strip cutter for cutting the specimen to be tested because of the importance attached both to the quality of the cut and the close size tolerance (Fig. 3). Cross-direction samples were given some precurl by pulling them around a common hexagonal lead pencil to prevent damaging the sample when it is inserted in the holder (Fig. 4).

Concora medium test data were obtained through the courtesy of the Container Corporation of America.

Single fluter data were obtained from The Institute of Paper Chemistry.

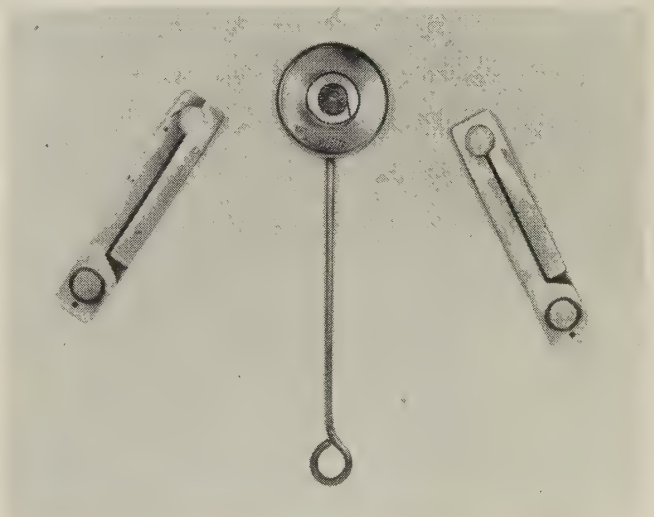


Fig. 2

L. K. BURNETT, Assistant to Production Vice-President, and R. H. GLASER, Development Chemist, The Ohio Boxboard Co., Rittman, Ohio.

Fig. 3

Flat crush values were obtained on 9-sq. in. circular samples using the 750-lb. National Forge compression tester equipped with abrasive platen surfaces.

Table I. Flat Crush

(Pounds/9 sq. in.)

Corrugating material	*Flat crush of corrugated board and (actual rating)*	*Evaluation of corrugating material and (predicted rating)* Machine direction ring crush	*Concora tester*	*Single fluter*
	Run 1, B Flute			
A	442(1)	25.2(1)	70(2)	42.3(2)
C	417(2)	24.2(2)	74(1)	44.8(1)
B	367(3)	23.1(3)	60(3)	38.5(3)
F	366(4)	21.0(4)	54(5)	32.9(5)
D	345(5)	20.8(5)	58(4)	37.5(4)
E	345(6)	20.4(6)	48(6)	32.5(6)
Correlation coefficients		0.938	0.872	0.782
	Run 2, B Flute			
G	431(1)	25.1(1)	76(1)	46.1(1)
A	420(2)	23.5(2)	70(2)	38.4(3)
D	356(3)	22.9(3)	70(3)	40.4(2)
B	354(4)	21.4(4)	51(6)	34.4(4)
F	352(5)	20.4(5)	52(5)	30.6(6)
E	325(6)	19.8(6)	54(4)	33.1(5)
Correlation coefficients		0.905	0.427	0.820

Top to bottom resistance to compression of finished containers was obtained on conditioned samples using a 10,000-lb National Forge compression tester (Fig. 5).

Table II. Flat Crush

(Pounds/9 sq. in.)

Corrugating material	*Flat crush of corrugated board and (actual rating)*	*Evaluation of corrugating material and (predicted rating)* Machine direction ring crush	*Concora tester*	*Single fluter*
	Run 3, C Flute			
A	392(1)	25.2(1)	70(2)	42.3(2)
B	386(2)	23.1(3)	60(3)	38.5(3)
C	348(3)	24.2(2)	74(1)	44.8(1)
D	334(4)	20.8(5)	58(4)	37.5(4)
E	310(5)	20.4(6)	48(6)	32.5(6)
F	309(6)	21.0(4)	54(5)	32.9(5)
Correlation coefficients		0.838	0.657	0.683
	Run 4, C Flute			
I	445(1)	28.6(2)	28.6(2)	45.8(2)
B	423(2)	29.6(1)	34.4(1)	49.1(1)
J	396(3)	26.3(3)	31.3(3)	39.9(3)
H	379(4)	24.6(4)	28.3(5)	36.6(5)
D	372(5)	24.2(5)	30.6(4)	39.8(4)
Correlation coefficients		0.881	0.462	0.887

Table III. Top to Bottom Box Compression

(Pounds resistance to $^3/_4$-in. deflection)

Corrugating material	*Resistance to top to bottom compression and (actual rating)*	*Evaluation of corrugating material and (predicted rating)* Cross-direction ring crush	*Concora tester*	*Single fluter*
	Run 1, B Flute, $15^3/_8 \times 13^3/_8 \times 15^1/_4$			
A	496(1)	19.7(1)	70(2)	42.3(2)
B	482(2)	19.1(2)	60(3)	38.5(3)
E	478(3)	18.1(3)	48(6)	32.5(6)
C	468(4)	18.1(4)	74(1)	44.8(1)
D	454(5)	15.0(6)	58(4)	37.5(4)
F	448(6)	16.5(5)	54(5)	32.9(5)
Correlation coefficients		0.900	0.165	0.411
	Run 2, B Flute, $20^1/_2 \times 12 \times 12$			
D	570(1)	18.2(1)	70(2)	40.4(2)
B	526(2)	17.8(2)	51(6)	34.4(4)
A	508(3)	17.0(3)	70(3)	38.4(3)
G	500(4)	16.5(4)	76(1)	46.1(1)
E	492(5)	15.4(6)	54(4)	33.1(5)
F	468(6)	15.8(5)	52(5)	30.6(6)
Correlation coefficients		0.848	0.367	0.432

The data, which are presented, are representative of the results obtained from this work. Tables I and II give typical

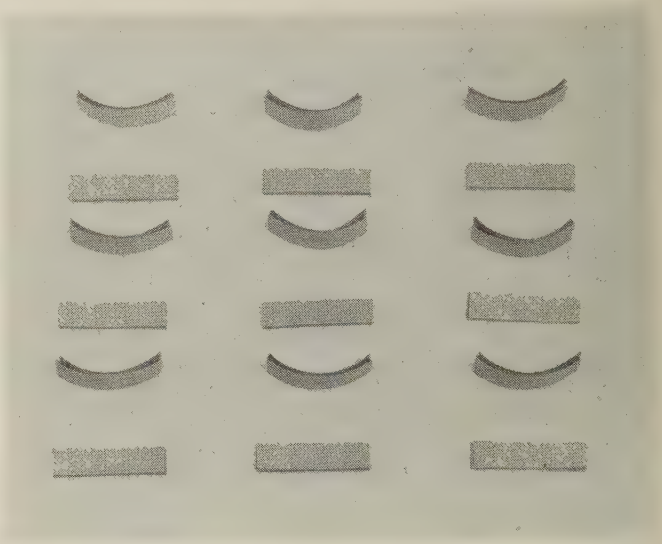


Fig. 4

results where the three test methods were used to predict flat crush levels on board fabricated using medium from nine

Table IV. Top to Bottom Box Compression

(Pounds resistance to $^3/_4$-in. deflection)

Corrugating material	*Resistance to top to bottom compression and (actual rating)*	*Evaluation of corrugating material and (predicted rating)* Cross-direction ring crush	*Concora tester*	*Single fluter*
	Run 3, C Flute, $15^3/_8 \times 13^3/_8 \times 15^1/_4$			
B	608(1)	19.1(2)	60(3)	38.5(3)
A	606(2)	19.7(1)	70(2)	42.3(2)
C	592(3)	18.1(4)	74(1)	44.8(1)
E	570(4)	18.1(3)	48(6)	32.5(6)
F	548(5)	16.5(5)	54(5)	32.9(5)
D	544(6)	15.0(6)	58(4)	37.5(4)
Correlation coefficients		0.931	0.587	0.631
	Run 4, C Flute, $14 \times 14 \times 8$			
B	746(1)	21.0(1)	34.4(1)	49.1(1)
H	695(2)	18.4(2)	28.3(3)	36.6(3)
I	620(3)	16.0(3)	32.5(3)	45.8(2)
Correlation coefficients		0.984	0.212	0.155

different suppliers. Examination of the correlation coefficients indicates that machine direction ring crush shows the highest degree of reliability in predicting flat crush.

Tables III and IV show our experience with the three methods in predicting resistance to top to bottom box compression at $^3/_4$-in. deflection of finished containers. An analysis of the correlation coefficients indicates that a high degree of correlations exists between cross-direction ring crush and top to bottom box compression.

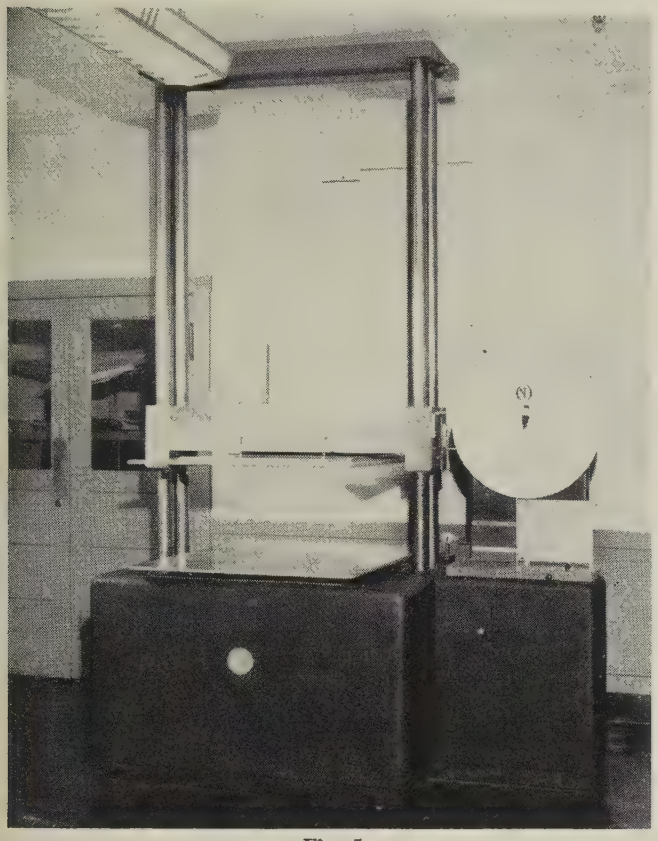


Fig. 5

To summarize, our data indicate that the machine direction ring crush gives us a better prediction of flat crush of both B and C-flute board with the corrugating materials we use than either of the other tests evaluated. In addition, we believe that the cross-direction ring crush gives us a better prediction of top to bottom box compression, then the other two tests. We therefore, feel that for our use the ring compression test offers the best way proposed to date to evaluate corrugating material.

We again remind you that our whole program is based on evaluating corrugating material submitted to us, and not on control of the manufacture of corrugating material. Therefore, we have time to thoroughly condition the samples before making our tests. We can also arrange to have all of this testing done by a limited number of experienced laboratory technicians rather than having to train inspection people to perform the tests around the clock. This makes our immediate problem much simpler than many of the rest of you. However, we too are desirous of finding a test which will not only satisfy our needs for evaluating corrugating material, but will also correlate with the results our suppliers obtain in their production control tests.

We are, therefore, presenting these data, which we admit to be limited in scope, with the hope that it will stimulate a free discussion of the subject. We hope that such discussion may lead to the evolution and adoption by the industry of a simple method for evaluating corrugating material that can be used both in the producing mills and in the fabricating plants to predict accurately flat crush and box compression characteristics of corrugated board made from a given medium. If the presentation of this paper accomplishes even a start toward such an objective, we will feel more than repaid for our efforts.

DISCUSSION

Q. (Burnett): What per cent increase in top load compression can be expected by increasing the cross-direction ring stiffness by 20%?

A.: I haven't that figure.

Q. (Richardson): How do you determine when to make changes in cooking operations on a routine basis to influence quality?

A.: With our batch process we depend mainly on the residuals of cooking liquors. However, that isn't the only factor. Other influencing factors are power required for refining, green liquor, and factors in the finished sheet.

Q. (Killinger): (1) Why do V3c boards so frequently fail on the water immersion test due to separation of liner from media? (2) Why can't adhesive be applied in sufficient quantity to overcome this?

A.: (1) On the acid setting formulas very little or no separation occurs after immersion. (2) With the alkaline formulation, often the single facer bond has a tendency to fail much sooner than the double backer bond. This single facer failure is a mechanical function since, in general, the single facer bond is the bond which gives greater difficulty even with conventional corrugating adhesives.

Q. (Burnett): We find that there is no correlation between data on compression tests prepared by box laboratories and commercial testing laboratories.

A.: At times we find differences in results, but, in general, our information is about the same as that developed by commercial laboratories.

Q. (Santmyers): Can silicate be used for sulphur impregnated medium?

A.: I myself have never run it. I think it should be tried to see if silicate does a satisfactory job. (A canvass showed that no one in the room had tried silicate for such a bonding job.)

Q. (Richardson and Carpenter): Please define status of process control department in your organizations—to whom responsible; and how large is the department.

A. (Carpenter): There is no actual control by the production department at the operating level. Control is under the laboratory with the department head being supervised by production manager. . .(Richardson): With five different mills, we have slightly different organization at each mill. In most cases, the process control is directly responsible to the mill manager. In some cases, to the superintendent. But in no cases is control directly connected with mill operation. The staff varies with size of mill, averaging 15 to 20 men in each plant. This, however, is in addition to technical service, which doesn't come under process control.

Q. (Richardson): At the TAPPI alkaline pulping session it was claimed that mediums made of high cooks don't give good flat crush, while neutral sulphate cooks give adequate flat crush. Is there an explanation for the above claims?

A.: A high cook gives a low flat crush (due to a greater reduction of the fiber and its interior structure), whereas today the desire is for a high flat crush. (The answer was evidently intended to state that low cooks, like the neutral sulphate, have less effect on the fiber structure, leaving it stronger, longer, and stiffer.)

Q. (Richardson): What tests have been made on semichemical medium by testing at the time it is made, and then later testing to see effect of elapsed time after storage?

A.: We keep in close touch with the customer, with routine follow-up; and then a subsequent recheck in the laboratory.

Q. (Santmyers): What is the relation for silicate of soda between Baumé and actual solids?

A.: There is a direct relationship, for instance the Baumé and solids for typical grades of silicate used as a corrugating adhesive are: Baumé 40.6, solids 37%; Baumé 41.6, solids 37.8%; Baumé 42.6, solids 38.6%.

Q. (Killinger): What wetting agent is used and how is it applied to improve adhesive sticking?

A.: Assuming liners are referred to; the ideal agent would be one that doesn't introduce any oiliness or resistance in developing the maximum tackiness of starch. Another requirement is that it does not foam. On test liners it is often applied at the calender stacks.

Q. (Hamilton): Please explain your Concora medium test. Does it correlate with runnability in the corrugator test?

A.: On our CMT we are attempting to hold very close to 70. For runnability it does give us a clue that the board will form

up. It tells us whether it will form up or break when going over the form rolls. The chart can be passed to the machine tender, so that corrections can be made at the time. (Further question: Does it correlate with runnability?) Yes. If you get a certain test, you should get the same results on the flat crush test.

Q. (Richardson): Can you show us the mechanics of quality control?

A.: Mr. Richardson showed some block control charts, where the plotted data were based on periodical tests. Red color was used for test data showing operations out of control and requiring immediate correction. Blue was used for less serious variations. Green was used for operations within satisfactory limits.

Q. What adhesive roll setting should be used for irregular caliper?

A.: It isn't possible to state definitely the setting without knowing the machine, model, and type. The setting varies from about 0.006 to 0.008 in. to secure a 3-lb. spread per 1000 sq. ft. As a general rule, it would be necessary to open up the machine to overcome irregular caliper.

Q. (Hamilton): Can dry medium (3% or less) be run? If so, what is the quality of the combined board?

A.: Dry medium can be run, but in most cases "cockles" will result—a sheet which will expand and warp. If excessively dry, it is necessary to add moisture. Close supervision is necessary in running dry medium.

Q. (Richardson): How do you measure freeness of semichemical pulps and is it possible to coordinate this with conditions in the refining, cooking, and handling on the machine?

A.: We use the Canadian TAPPI test. We have been able to correlate, but I can't give you the figures for a given furnish. Freeness doesn't give all of the answers, but it is a good tool.

Q. (Hamilton): What moisture range can be tolerated without slowing the corrugator?

A.: On semichemical I prefer 7½ to 8% as a good range. As to variation across the sheet, I think little trouble is experienced with 7% on one side and 8½% on the other; at least it would give such little trouble that adjustment of steam showers would compensate. There is trouble with a variation of more than 1½%. At high speeds, more adhesive would have to be applied.

Q.: What is the most desirable moisture content?

A. (Carpenter): We actually run to customer specification—usually 6 to 8%, but some customers want 9%. We prefer 7 to 8% ourselves.... (Richardson): We have no standard. The requirements of customers vary so widely that we are trying to run to customers' specifications. What the limits should be, I am not sure.

Q. (Santmyers): What is the maximum water drop test allowable when using neutral sulphate, using silicate adhesive?

A.: Sixty seconds down to 2 sec.

Q. (Killinger): How do you eliminate washboarding when using Piccolite?

A.: Washboarding is usually due to excess adhesive or to running too slow. Set up the machine to use less adhesive. Wetting the board helps to use less adhesive. I have had no experience with Piccolite. (Mr. Hamilton added that washboarding will usually show up with lightweight liners; and, at the same time, it is usually found that the medium has a high moisture content.)

Q. (Hamilton): What instrument is used for determining moisture content in board components at the corrugator?

A.: If the content is high, we use one like the Hart. However, we also have an oven and scales to prove the readings.

Q. (Killinger): Please describe method of prewetting corrugated flute tips.

A.: I prefer not to discuss the question, because it is being done by companies we have assisted, but it is their property.

Q. (Burnett): How many samples were used in the correlation of your figures?

A.: There were ten samples tested for each result shown.

Q. (Richardson): In your statistical presentations, do you use business machines such as IBM for tabulating and producing summaries?

A.: No. We use normal office calculators. A lot of the work is done on simple adding machines which will multiply. We don't literally use statistical control.

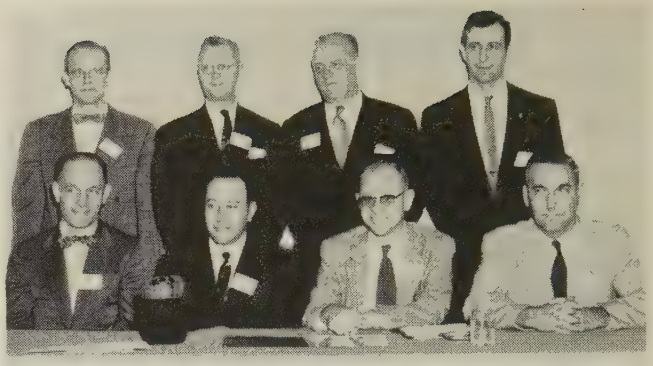
Q. (Killinger): Can you give more information on the material that fluxes on the corrugator?

A.: It is a resin derivative, sold as Vinsol.

Q. (Hamilton): How does heavy caliper corrugating medium cause leaning flutes?

A.: With 11 to 12 point corrugating medium, it is difficult to set the forming rolls, so that the board doesn't break but will mold properly. Heavy board does not fluff out or does not return properly at the fingers; and after meeting the pressure roll, it doesn't release properly. Also, it doesn't draw properly in feeding across the fluted roll leading to the corrugator roll nip. The side walls of the flutes, through squeezing, become weak; so that, in general, the result is malformation.

Q. (Santmyers): What transfer roll clearances are recommended in using silicate on the single facer?



Seated (left to right): L. K. Burnett, Ohio Boxboard Co., Rittman, Ohio; Burt Mendlin, Cornell Paperboard Products Co., Milwaukee, Wis.; Clay Richardson, Mead Corp., Chillicothe, Ohio; C. E. Jakeway, American Box Board Co., Grand Rapids, Mich. Standing: Donald Santmyers, E. I. du Pont de Nemours & Co., Inc., Chicago, Ill.; J. E. Killinger, Penick & Ford, Ltd., Cedar Rapids, Ia.; E. R. Carpenter, The Weston Paper & Mfg. Co., Terre Haute, Ind.

A.: It will vary from machine to machine, but ranges from 0.025 to 0.033 in.

Q. (Hamilton): Would running of V-board be affected by changes in plant temperatures or outside temperatures?

A.: I don't think so because the difference from Summer to Winter is so small in relation to the greater heat on the machine. There is more apt to be difficulty with humidity, particularly in the Winter when humidity is low.

Q. (Killinger): What adjustment in the ratio of borax to caustic should be made for dense liners? What do you do about dense liners to improve cases sealing properties?

A.: In corrugating the borax might be cut 30 to 50% to make an adhesive that will stay fluid longer so as to get better penetration. To offset this, it is desirable to add one or two extra bags of raw starch so that you eventually get a better bond.

Discussion—During the course of the questions and answers, R. T. Cassady, vice-president of Jackson Box Co., stated that he was anxious for TAPPI to get down to cases. He was appreciative of the fine work done by the committee, but he explained that he felt it necessary that decisions be made on standards and tolerances on components which could be used by a man running the machines. In reply, Burt Mendlin, chairman of the Corrugated Container Committee, explained that the present conference was the first where board and box people were brought together at the same meeting. He said that some research had been accomplished, and he hoped the board and corrugated people were on the road toward some answers which would be valuable to men in actual plant operation.

Q. (Killinger): Can we conclude from your discussion that waterproof starch adhesive on 0.023 in. liners would require more crown and, if so, is it necessary on both the top corrugator roll and pressure roll? For immediate relief, is the silicate coating on the pressure roll the answer?

A.: This question was, perhaps, motivated by the discussion of the difficulty with running high caliper wet-strength board with an acid condensing urea formaldehyde resin. Such adhesives do not penetrate as rapidly as would an alkaline regular corrugating starch formulation, and we know from experience that it is more difficult to get a tearing bond on the single facer than on the double backer with all waterproof adhesives. The adhesive, regardless of whether it is an acid or alkaline condensing type. does not dissolve or disintegrate even though it is soaked for a matter of weeks in water. However, the single face side can at times be stripped after soaking and without pulling fibers as deeply as is realized at the double backer. It is our belief that this difference between single face and double face operation with the same board components and same waterproof adhesive may be due to two essential differences between these two glue machines. In the first place, the adhesive at the single facer does not after being pasted *in situ* remain fluid and in a penetrating state nearly so long as is the case at the double backer. Secondly, the adhesive might cure somewhat differently at high temperatures and under conditions of high humidity such as is realized for 30 to 45 ft. in the double backer. Of these two differences, we think the lack of penetration is the most significant, and in order to get better penetration excess pressure is exerted at the single facer. This excess pressure can well spring or bow the rolls. The Langston Machine Co., I know, has done a considerable amount of work with reference to changing the crown on machines designed primarily for making V-board,and as much as

25 to 30% increase in crown has been used effectively. With reference to the application of silicate of soda so as to build up the effective crown, this was tried just to show or prove that the crown was not sufficient. It is very difficult to apply any material which adheres to the rolls in a uniform manner, and while the application of silicate did improve the bonding of the center of the sheet it nevertheless did mar the sheet rather badly.

Q. (Killinger): Is there a possibility of using a small amount of borax in an alkaline water-resistant paste?

A.: This is a controversial question and depends somewhat, I believe, on the formulation and type of alkaline setting resin involved. We have pretty well convinced ourselves that with the resorcinol resin condensed with a dual catalyst such as caustic and formaldehyde in solid fiber production the presence of borax interferes with the development of water resistance. It is believed that borax reacts with starch through the same groupings as involved in resin condensations, and it is quite possible that if this is so, then borax and resin would be competing for the same groups and, therefore, it might well interfere with cross-linking or condensation with starch and resin to make an irreversible or insoluble adhesive.

Q. (Killinger): Could not the same effect as adding wetting agent to sized liner on the paper machine be obtained by spraying wetting agent on board on the corrugating machine, say at the unwind stand?

A.: Yes, a suitable wetting agent might be sprayed or misted onto the paper surfaces to be joined just ahead of the application of the adhesive. In fact, we have done this in several cases, and it is our belief that some wetting agents are more effective when applied at the corrugator than when applied on the paper machine.

Q. (Killinger): Do you believe that the lower belts contribute anything to the removal of water through the double backer?

A.: We have not made any actual checks to determine if the lower belt in the cooling section does remove moisture. This would be difficult to accomplish while the corrugator is in operation. Perhaps it could be determined simply by saturating with steam the lower belt to see if it had any effect on production. I am sorry that we do not have more exact data, but from a theoretical standpoint I do not believe there is much water removed by the lower belt. It may be that the manufacturers of corrugating belts could be of assistance.

Q. (Killinger): What is the average consumption of starch adhesive per 1000 sq. ft. (1) on the single facer and (2) on the double backer for each of the flutes?

A.: (1) With a 3-lb.-spread 1000 sq. ft. being considered normal, good operation, it has been our findings that it is customary to use slightly more on the double backer than on the single facer. Possibly 1.4 lb. at the single facer and 1.6 lb. at the double backer would be average. (2) B and C-flute boards which have more flutes per foot than A-flute should, theoretically, require less adhesive per flute, but since there are more flutes it is my understanding that there is really not too much difference in the spread between A and B-flute. Some producers do use factors to change B and C-flute production into A-flute equivalent. However, a number of manufacturers who have studied this find there is not too much difference, and the conversion, therefore, may not be too valid. This is still controversial.

Q. (Burnett): Have you tried the ring test with different diameters from that shown?

A.: Yes we have tried $^1/_2$ by 6 in. but prefer the $^1/_2$ by 2 in. for corrugating material.

Q. (Burnett): Were the CMT prediction formulas used as published on a 9 or 10-sq. in. basis?

A.: Our results are all on 9-sq. in. flat crush samples.

Q. (Burnett): Is there any correlation between $^1/_2$ by 6 in. ring crush and $^1/_2$ by 2 in. ring crush. Which do you prefer?

A.: We have not been able to correlate these two tests. We definitely prefer the $^1/_2$ by 2 in. size for corrugating material but we do use $^1/_2$ by 6 in. or tests on liners.

Q. (Burnett): In theory what is the relation between ring test results and the flat crush test to be expected on the finished board in the box made from a given medium?

A.: In terms of our test results an MD ring crush test of 22 produces roughly 360# p.s.i. (on a 9-sq. in. sample) on C flute board.

Q. (Burnett): We see no theoretical relationship between ring stiffness and corrugated medium. How do you explain your rather good correlation coefficients?

A.: We haven't investigated this relationship from a theoretical standpoint. Our results are based on actual test results under carefully controlled conditions.

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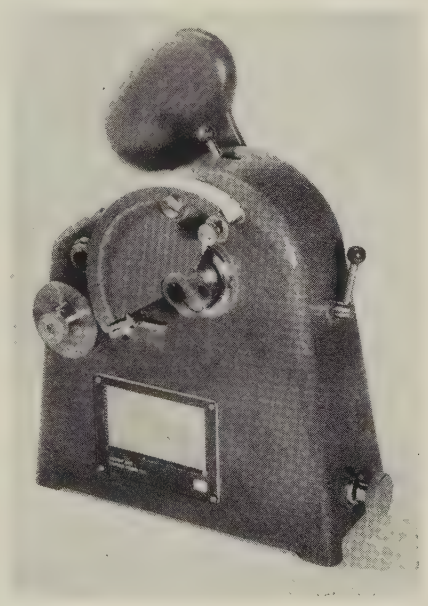

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Microscopical Identification of Paper Fillers*

TAPPI Suggested Method T 650 sm-55

(THIS SUGGESTED METHOD IS UNDER THE JURISDICTION OF THE MICROSCOPY COMMITTEE)

This method describes the procedures for identifying the mineral constituents of paper products by means of the microscope. The methods described have certain advantages over the usual qualitative chemical procedures. Comparatively speaking, only very small samples are required. Tests for the presence of any one constituent can be made without preparatory separations. In many cases the actual chemical compounds are recognized at once without the need to assume a theoretical combination of ions. In addition, microscopical methods give immediate information as to the particle size and shape.

Procedures are given for the recognition of diatomaceous earth, talc, clay, calcium sulphate, calcium carbonate, and compounds containing the ions of Ca, Zn, Ba, and Ti. Other less common mineral fillers may sometimes be detected by variations of these procedures or by other chemical and optical tests found in the literature.

Before using the method, the analyst should examine samples of known filler content to become familiar with the techniques. Particular care should be exercised in examining fillers containing titanium dioxide. This filler is frequently used in combination with other fillers, and because of its high index of refraction and small particle size it can sometimes cover small quantities of other fillers, such as clay, so that they are difficult to identify.

EQUIPMENT

1. *Microscope.* A compound microscope equipped with oculars and objectives to give magnifications between 40 and 100 diameters and between 200 and 300 diameters. More elaborate instruments with polarizers and analyzers are not essential for the procedures given, but give valuable information in special instances.

2. *Slides and Cover Glasses.* Standard slides (1 by 3 inches) of clear, colorless glass with No. 2 cover glasses.

3. *Glass Rods.* Thin glass rods, or glass rods drawn out to tapered ends.

4. *Micro Burner.* A micro burner or a Bunsen burner equipped to give a micro flame is useful, but other forms of heating may be used.

5. *Reagent Bottles.* The solutions should be in small bottles with droppers and the solid chemicals in small bottles with glass stoppers. The hydrogen peroxide should be in a dark-colored bottle.

REAGENTS

A. *Dilute Hydrochloric Acid.* 1 part conc. HCl to 4 parts water by volume.

B. *Dilute Sulphuric Acid.* 1 part H_2SO_4 to 4 parts water by volume.

C. *Dilute Nitric Acid.* 1 part HNO_3 to 4 parts water by volume.

D. *Acetic Acid.* 1 part glacial acetic acid to 4 parts water by volume.

E. *Hydrogen Peroxide.* 3% solution of H_2O_2.

F. *Solid Iodic Acid,* HIO_3.

G. *Solid Potassium Mercuric Thiocyanate.*

H. *Solid Ammonium Sulphate,* $(NH_4)_2SO_4$.

I. *Distilled Water.*

TEST SPECIMEN

The test specimen shall be a sample of the paper ash obtained according to TAPPI Standard T 413 m.

PROCEDURE

Examine portions of the ash for each of the suspected mineral fillers as follows:

Diatomaceous Earth, Talc, and Clay

Diatomaceous earth, talc, and clay can usually be recognized by the appearance and size of the particles. Prepare a dispersion of the material on a microscope slide. Transfer a small amount of the ash to a drop of water on the slide and cover with a cover glass, which is then moved around with gradually increased pressure to separate the particles.

The diatomaceous earths are the fossil remains of microscopic plants. Chemically, they are nearly pure SiO_2. They are recognized by their characteristic shapes and symmetrical markings. Although many shapes and forms are found, the material is readily identified. The rods and honeycomblike sections are often the first particles to be recognized in an unknown specimen at low magnification (Fig. 1). Higher magnifications may be necessary to show the details of some of the more intricate designs (Figs. 2 and 3).

Usually, talc particles are larger than either the diatomaceous earth or clay particles, and the sharp

* This method is suggested by the Standards Committee as being the most suitable to date. It is *not*, however, a TAPPI Standard. Criticisms are earnestly requested and should be sent to R. G. Macdonald, Secretary, Technical Association of the Pulp and Paper Industry, 155 E. 44th St., New York 17, N. Y.

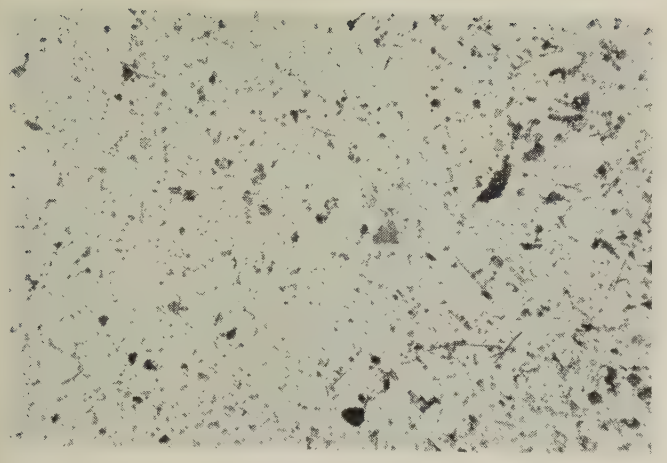

Fig. 1. Diatomaceous earth. 75×

outlines of a large proportion of the particles can be observed under low magnification. Talc particles are irregular in outline and so-called fibrous talcs are longer in one dimension. A talc similar to the talcs used in most papers is shown in Figs. 4 and 5, which are photo-

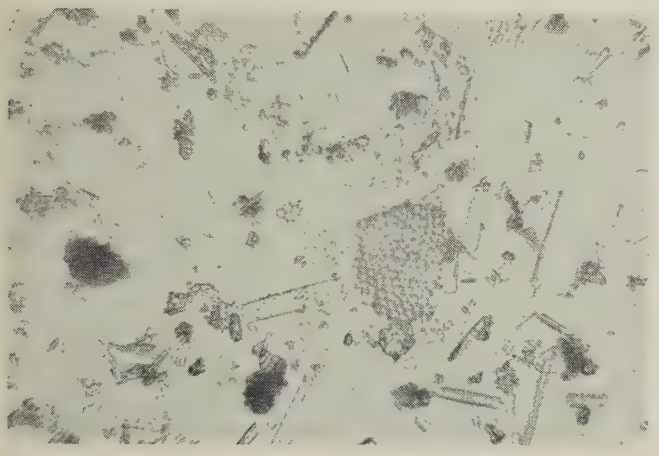

Fig. 2. Diatomaceous earth. 400×

micrographs of a sample at low and high magnifications, respectively. Figure 6, a photomicrograph at low magnification, illustrates one of the fibrous agalite talcs.

If the majority of the particles on the slide are very

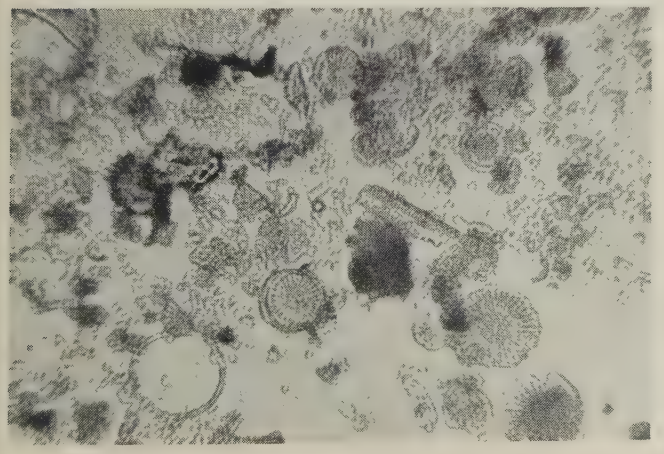

Fig. 3. Diatomaceous earth. 400×

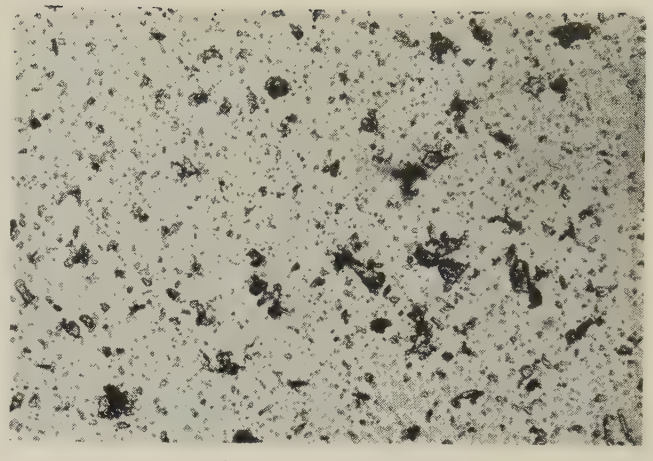

Fig. 4. Talc. 75×

small, usually too small to be resolved at low power, either clay or a chemically precipitated filler is indicated The particles of natural fillers are irregular and not uniform in size; those of precipitated fillers are more regular, more uniform, and usually much finer. Clay is identified by the presence of characteristic flat plates of kaolinite and mica which are comparatively large. Slowly raising the microscope tube slightly out of focus will cause some of these plates to stand out as bright areas in the field and so help to locate them. The outlines of the small particles of clay, which comprise the bulk of the material, can be brought out only at higher magnifications. Figure 7 is a photomicrograph of a clay at low magnification, and Fig. 8 is the same at high magnifications.

Calcium Compounds

The presence of Ca compounds is recognized by the formation of characteristic crystals of $CaSO_4$ or of $Ca(IO_3)_2$. The more common Ca compounds used as paper fillers are $CaCO_3$ and $CaSO_4$, and the tests described here will differentiate between those and will also show the presence of Ca ions.

The following tests involve the addition of acids as the first steps in preparing the slides and any effervescences at this point will indicate the prescence of a carbonate. Often, however, the carbonate is destroyed when the paper is ashed. In this case, the ash will give a strongly alkaline reaction with phenolphthalein.

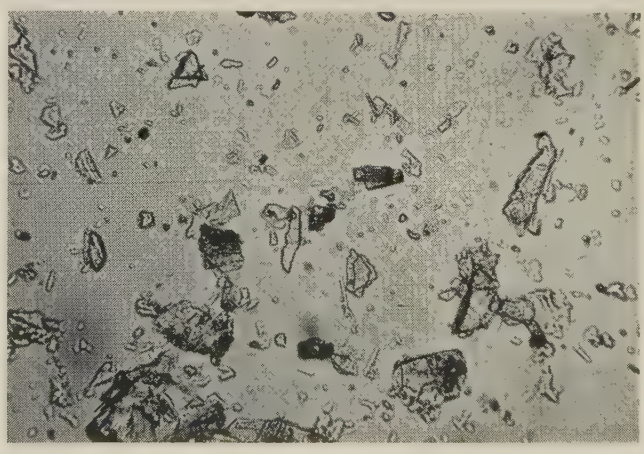

Fig. 5. Talc. 75×

Fig. 6. Fibrous agalite talc. 75×

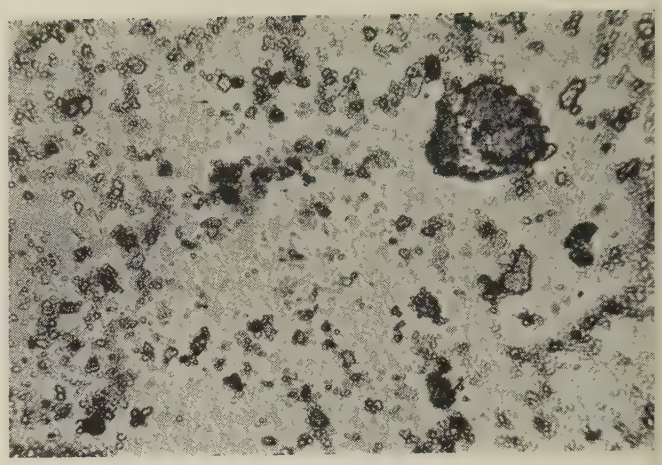

Fig. 8. Clay. 400×

To test the ash by the formation of $CaSO_4$ crystals, place a drop of dil. HCl on one corner of a slide and add a small quantity of the sample to it. Evaporate the drop to complete dryness by holding the corner of the slide above a micro-burner flame. Hold the slide slightly inclined down toward the drop, and apply the heat near the top edge of the drop to prevent it from spreading upward across the slide. Add a drop of water to the cooled residue; if the sample contains $CaSO_4$ added as filler, individual and radiating clusters of needlelike crystals will form. If the concentration of $CaSO_4$ happens to be low, warming the solution will hasten the crystallization. Examine the edges of the drop first, since it is there that the crystallization will start. These crystals grow rapidly and, as they do so, some of the needles will be seen to grow in width and finally form overlapping arrow-tail formations. These are positive identification of Ca. Figure 9 is a photomicrograph of $CaSO_4$ at low-power magnification. A group of arrow tails appears near one corner of the field. Figures 10 and 11 are photomicrographs at high magnification showing masses of needlelike crystals with arrow tails fully formed, and several others forming. If the characteristic crystals do not form, prepare a new slide and add dil. H_2SO_4 directly to the evaporated residue. If the characteristic crystals then form, the presence of the Ca ion is indicated.

To determine the presence of Ca ions by the iodate method, mix a small amount of ash with a drop of water on a slide and add a small quantity of HIO_3. Usually, the HIO_3 is dissolved in a separate drop of water, which is caused to flow into the sample by drawing a glass rod from the one drop into the other, accompanied by a slight tilt of the slide. The $Ca(IO_3)_2$ forms as

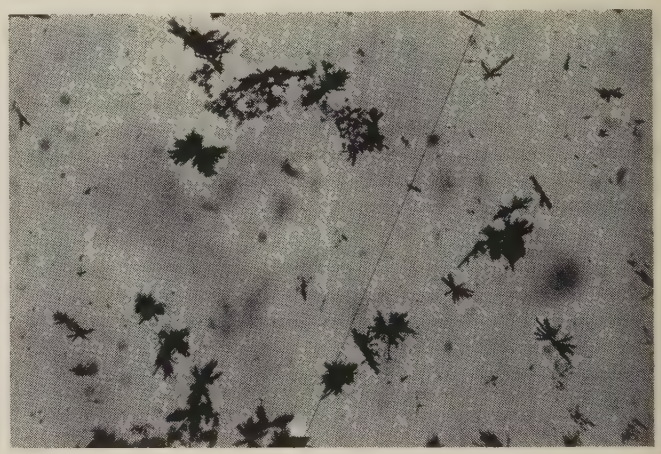

Fig. 9. Recrystallized calcium sulphate. 75×

distinctive, odorless, diamond-shaped crystals (Fig. 12). It may be necessary to start crystallization by scratching the slide lightly with a glass rod, as the $Ca(IO_3)_2$ tends to form supersaturated solutions. At times, the crystals form slowly. The slide should, therefore, be

Fig. 7. Clay. 75×

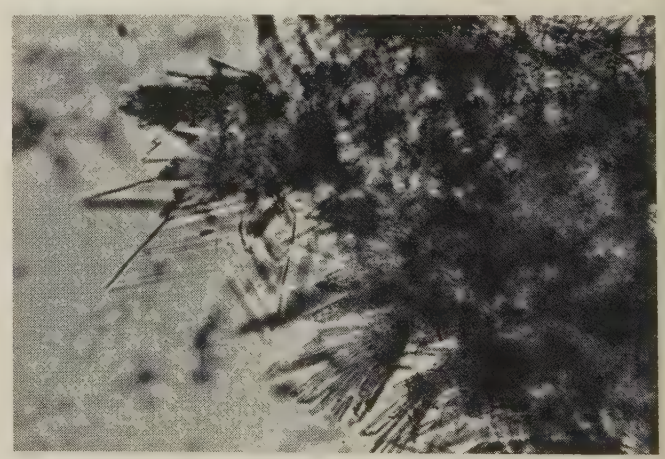

Fig. 10. Recrystallized calcium sulphate showing arrow tails fully formed. 400×

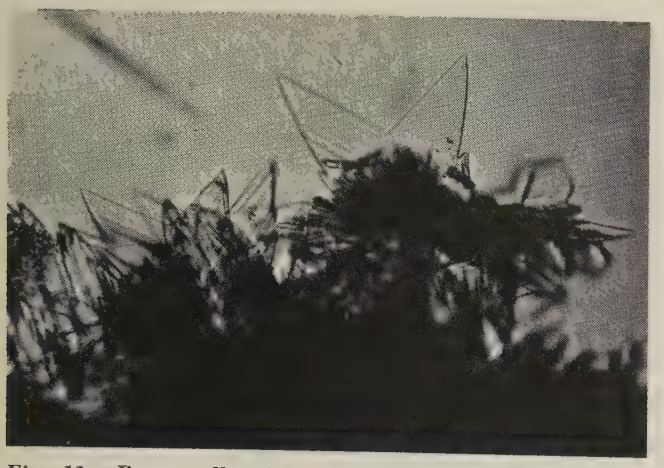

Fig. 11. Recrystallized calcium sulphate showing arrow tails fully formed. 400×

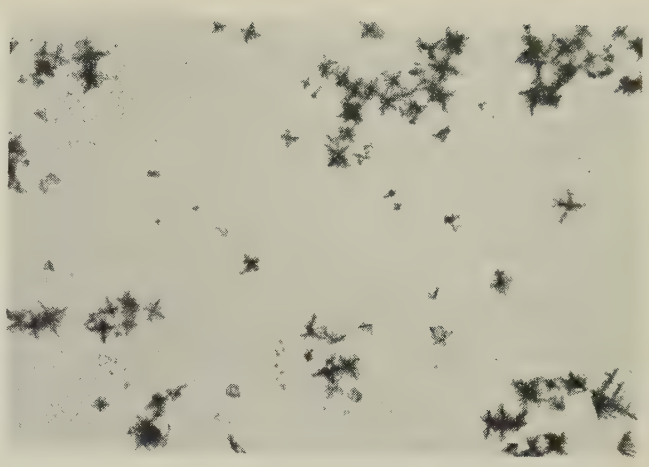

Fig. 13. Zinc mercuric thiocyanate crystals. 75×

laid aside and examined again from time to time while other slides are being prepared.

If care is taken to use only a small quantity of the solid HIO_3, it may be dissolved directly in the drop of water containing the unknown. A short cut used by experienced analysts is to add solid HIO_3 to the original suspension prepared for examination for diatomaceous earth, talc, and clay. This procedure serves a three-fold purpose. The HIO_3 immediately indicates the presence of carbonates by causing them to effervesce; it aids in dispersing the filler particles; and it reacts to confirm the presence of Ca if this ion is present.

Zinc Compounds

The presence of Zn is confirmed by the formation of characteristic crystals of zinc mercuric thiocyanate. To put the Zn compounds into solution and to avoid the possible interference by strong acids, the sample is repeatedly evaporated to dryness with HNO_3. To do this, add a small quantity of ash to a drop of dil. HNO_3 on one corner of a slide, and evaporate to complete dryness, using the procedure described earlier. When the residue is dry and cool, add a second drop of HNO_3 and again evaporate. Repeat a third time, and then add a drop of water and slightly acidify with acetic acid. Stirring the water drop with a thin glass rod moistened with acetic acid gives good results. Allowing a drop of acetic acid to run down the bottom inch or so of the rod and shaking off any free drops gives the right amount to use.

In a second small drop of water on the slide dissolve some potassium mercuric thiocyanate. Use several times as much of this reagent as was used of the ash. Flow the reagent drop into the unknown. If Zn is present, colorless crystals in the shape of feathery crosses are formed (Fig. 13). Those crystals appear black by transmitted light but white on a black background by reflected light. If numerous prisms and square tablets are obtained, repeat the test, paying more attention to the completeness of the evaporations, the concentration of acetic acid, and the concentrations of the unknown and reagent solutions.

Barium Compounds

The test to confirm the presence of Ba compounds depends on the formation of characteristic $BaSO_4$ crystals by recrystallization from H_2SO_4. Add a very small quantity of unknown to a generous drop of dil. H_2SO_4 on one corner of a slide and concentrate by heating over the burner until strong white fumes appear. Do not heat the slide too rapidly. When the slide is partly cool, breathe on it a few times to start recrystallization. If Ba is present, it is evidenced by the formation of $BaSO_4$ crystals which appear as feathery crosses with a marked tendency for two of the adjacent arms to be longer than the other two (Fig. 14). These

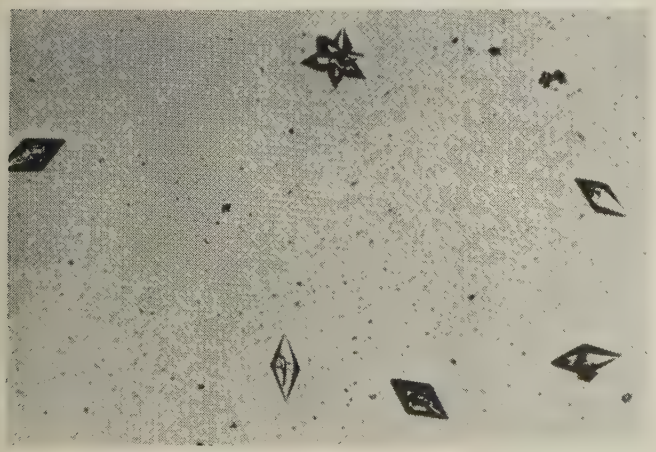

Fig. 12. Calcium iodate crystals. 75×

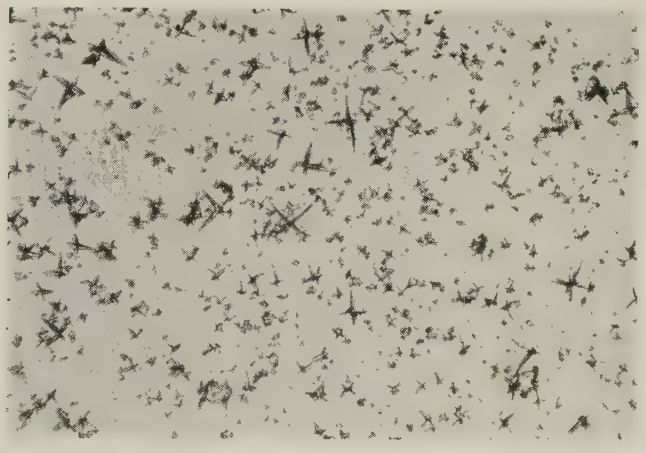

Fig. 14. Recrystallized barium sulphate. 75×

crystals may develop slowly, and considerable time should be allowed for their appearance.

This procedure also provides another indication of the presence of Ca. From the concentrated acid, $CaSO_4$ recrystallizes as very small rounded grains with short hairlike projections on either end.

Titanium Compounds

The experienced analyst will learn to suspect the presence of TiO_2 from the appearance of the sample when it is examined under the microscope for clay or talc. Under transmitted light, TiO_2 appears as minute pitch-black particles.

The confirming test for Ti is an adaptation of the qualitative color reaction. The microscope is not used for this test. Place a fairly large quantity of the unknown in a drop of dil. H_2SO_4 on one corner of a slide. Add solid $(NH_4)_2SO_4$ and slowly evaporate the drop until strong white fumes have appeared for several seconds. After the drop has cooled, add sufficient water to bring it back to approximately its original volume. Upon adding 3% H_2O_2 to the drop on the slide, the characteristic yellow-to-orange color will appear if Ti is present.

If a large amount of the unknown was used and the yellow color developed is very weak, repeat the test with a lesser quantity of the unknown and compare with a known sample of clay. Some clays contain sufficient Ti to show by this test when a large sample is used. Varying the quantity of sample will, however, distinguish between the Ti naturally in the clay and that which has been added as filler.

REPORT

Report the mineral fillers found present and any additional data that might be of value, such as particle size, shape, and color.

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Compression Wood in Pulpwood*

TAPPI Tentative Standard T 20 m-55

(THIS STANDARD IS UNDER THE JURISDICTION OF THE FIBROUS MATERIALS TESTING COMMITTEE)

Compression wood is a type of abnormal structure that forms on the lower sides of leaning trunks and the branches in all coniferous species. For most uses of wood, its presence is undesirable; in pulpwood it can cause lower pulp yields, lower pulp strength, and pulp bleaching difficulties. Its effects vary according to the form and amount of abnormal fibers present. Though compression wood may amount to a considerable proportion in some logs, the over-all amount is generally not large enough to give serious trouble in pulping. It can occur, however, in large amounts in certain trees and so affect the general quality of pulpwood cuttings. An influx of such material into a mill system can well be the unexplained cause of sudden fluctuations in pulp quality.

Compression wood is ordinarily distinguishable in a log's transverse section by eccentric and wide annual-growth rings and unusually large summerwood areas in the wider parts of the rings. It may be confined to a few annual rings, or it may comprise from one third to one half of the cross section. Compared to the normal wood, it has a "lifeless" appearance which is the result of lack of contrast between the spring wood and summer wood. It differs from normal wood in gross anatomy, minute structure of the individual fibers, and in chemical composition. It occurs in gradually merging forms, from that which differs distinctly from normal wood to that which is recognizable only by microscopical examination. In general, compression wood may be divided into two broad classes: (a) severe and intermediate forms, which are conspicuous and easily recognizable on sight (Figs. 1 and 2); and (b) borderline forms, which require some experience to recognize with the unaided eye and may need microscopical examination to identify positively.

This method is concerned only with the detection and measurement of the compression wood that can be recognized by unaided vision. Ordinarily this is sufficient for operating purposes. Microscopical and chemical tests may be required in special cases.

APPARATUS

1. *Viewing Devices.* This equipment is used only as an aid in determining the presence of compression wood and so may consist of any convenient means for viewing thin cross sections of pulpwood by light transmitted through the section. Such a viewer may be a box of suitable size containing a 100- or 150-watt electric lamp, provided with openings in the sides for ventilation and with a rectangular or circular aperture or window in the top over which the log section is placed. The aperture, which should be at least as large as the average section of pulpwood, should be covered with a clear glass plate set in flush with the top surface of the box. Paperboard or lightweight sheet-metal shields may be provided for shutting off

*This method has been approved as a tentative standard by the Standards Committee. Criticisms are earnestly requested and should be sent to R. G. Macdonald, Secretary, Technical Association of the Pulp and Paper industry. 155 E. 44th St., New York 17, N. Y.

light passing through the aperture around the outside of the specimen. Another type of viewing device can be made by forming a rectangular or circular tube from paperboard or lightweight sheet metal. The specimen is held or clamped to one end of the tube and viewed from the other end against strong sunlight, an electric light, or a powerful flashlight. Best effects are obtained by using these devices in a dimly lighted or darkened room.

2. *Ground-Glass Tracing Plate or Table.* For use in alternative procedure A. A plate glass about 12 inches square with one surface ground or etched is fastened in a wooden frame about $1^1/_4$ inches wide with the etched surface set flush with the frame. Although not necessary, it is convenient to hinge the framed glass, with the etched surface up, as a lid to a shallow box about $2^1/_2$ inches deep. Within the box, a synthetic sponge (rubber has been found satisfactory) with approximate dimensions of 7 by $4^1/_2$ by 2 inches, is glued to about the middle of the bottom. When a specimen disk of pulpwood is laid upon the sponge and the glass lid of the box closed and latched, the compressed sponge should cause the disk to be pressed upward firmly against the lower (unetched) surface of the glass plate so that the marked outlines of the compression wood are plainly visible through the glass.

3. *Planimeter.* For tracing areas of compression wood.

QUALITATIVE DETECTION

The severe and intermediate forms of compression wood are easily recognized, once the observer becomes familiar with their general characteristics. The borderline form is less easily detected and it requires some practice to distinguish it from normal wood. The viewing box is useful for training the observer and to aid in deciding doubtful cases.

Fig. 1. Cross section of loblolly pine with annual rings of moderate width; normal wood in upper portion and pronounced compression wood in central part of lower portion

Fig. 2. Cross section of black spruce pulpwood showing pronounced compression wood in lower portion

Very severe compression wood ordinarily can be detected by its comparatively wide and eccentric annual rings containing a high amount of summerwood which is not so hard as normal summerwood nor, when dry, as dark. This gives compression wood a somewhat "lifeless" appearance. It is in detecting the less severe forms of compression wood that the viewing box is helpful.

Procedure

With a reasonably sharp saw cut transverse sections of the wood about $^1/_8$ to $^3/_{16}$ inch thick from the pulpwood log. Sanded surfaces are unsatisfactory because in sanding the cell cavities become filled, which destroys the translucence of normal wood and thus its contrast to compression wood. When the thin sections are placed in the aperture of the viewing apparatus, the compression wood appears relatively opaque as compared to the translucent normal wood (Fig. 3).

Note: Pitch-soaked wood is highly translucent regardless of whether or not it contains compression wood. Extremely pitchy wood is not well adapted for this test.

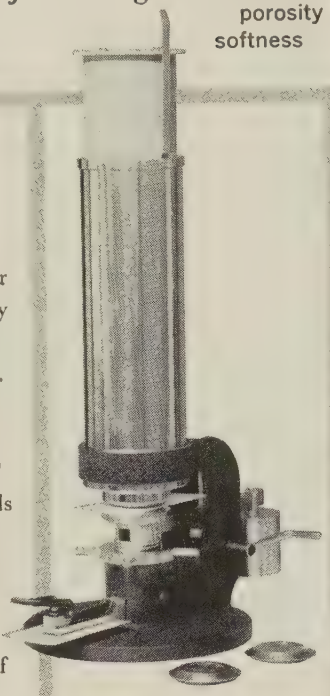
QUANTITATIVE MEASUREMENT

The degree of the reduction in pulp quality by compression wood is in proportion to the type and amount present. The amount is easily measured on transverse sections of the pulpwood logs.

Test Specimens

Saw a disk approximately 1 inch thick from a representative number of logs, or use the thinner sections prepared for the qualitative detection. The number

1 INSTRUMENT *for Testing* smoothness
porosity
softness



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of test specimens will depend on the variability of the volume of compression wood between logs and can be determined by approved sampling procedures. A trial sample may consist of one disk cut from each of the logs selected for specific gravity determination according to TAPPI Standard T 7 p, Weight-Volume Measurements of Pulpwood and Chips.

Procedure

Outline the areas of compression wood on the damp surfaces of the disks with an indelible pencil and measure these areas by one of the following procedures:

A. Place the ground-glass tracing table on the disk with the ground surface up, or if the table is hinged to a box as described above, place the disk on the sponge and close and latch the lid. Trace with the planimeter the outline of the disk inside the bark visible through the glass. Measure with the planimeter the areas of compression wood outlined with indelible pencil on the disk.

B. Lay a sheet of relatively thin paper on the disk and trace onto the paper the visible outline of the disk inside the bark. If the bark has previously been removed, the outline of the disk can be drawn by laying the disk on the paper. Lay the paper on the disk and trace on the paper the visible outlines of the compression-wood areas. Measure the traced areas with the planimeter.

Report

Report the volume percentages of compression wood in the sample. If the sample disks have been cut from

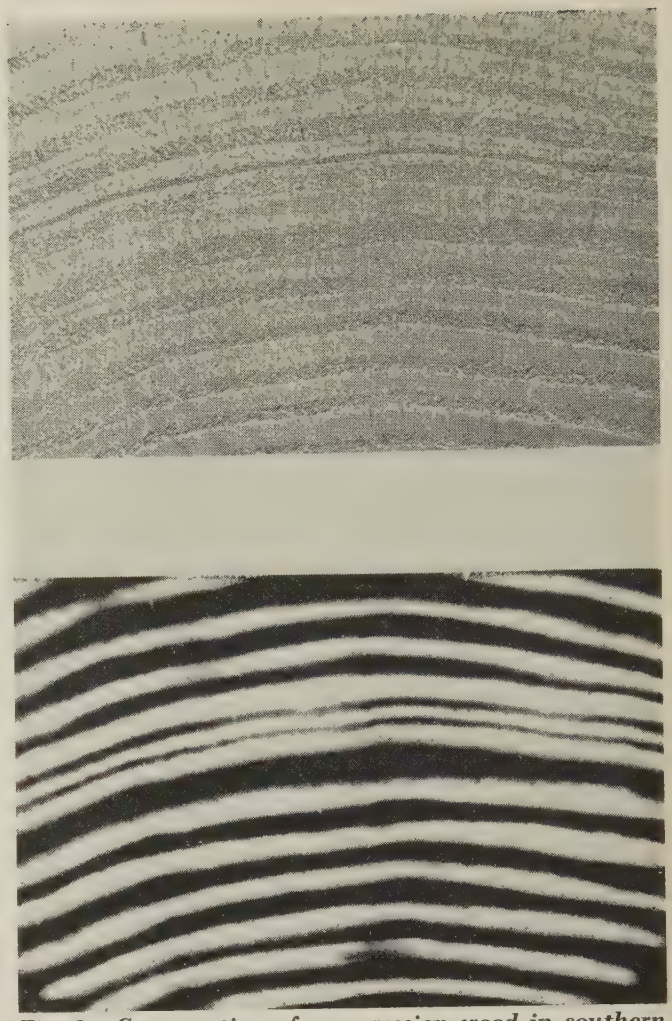

Fig. 3. Cross section of compression wood in southern yellow pine $^{3}/_{16}$ inch thick. Top view: photographed in reflected light. Bottom view: photographed by transmitted light. Note opacity of summerwood

logs of approximately equal length, the percentage by volume is equivalent to the average of the percentage areas of the compression wood in the disks. The average should, of course, include the disks in which the compression wood is zero.

Report the weighted average volume percentage when: (1) the sample consists of less than 11 disks: or (2) the highest percentage area of compression wood in the disks and the largest disk area are, respectively, more than twice the lowest of these values. Denoting this weighted average by W, it is calculated from the formula:

$$W = \frac{100C}{T}$$

where C = sum of compression-wood areas in all disks and T = sum of total areas of all disks.

REFERENCES

"A Simple Device for Detecting Compression Wood," *U. S. Forest Products Laboratory Report* 1390 (Dec., 1941).

Pillow, M. Y., "A New Method of Detecting Compression Wood," *J. Forestry* 39, No. 4: 385–387 (April, 1941).

Pillow, M. Y., Schafer, E. R., and Pew, J. C., "Effect of Compression Wood in Black Spruce and Its Effect on Properties of Groundwood Pulp," *Tech. Assoc. Papers* 19: 178–180 (June, 1936); *U. S. Forest Products Laboratory Report* R1288 (April, 1936).

Pillow, M. Y., Chidester, G. H., and Bray, M. W., "Effect of Wood Structure on Properties of Sulfate and Sulfite Pulps from Loblolly Pine," *Southern Pulp and Paper J.* 4, No. 7: 6–12 (Dec., 1941).

UNITED STATES PATENTS ON PAPERMAKING

Third Quarter, 1954

Compiled by W. B. Weber

THE following list of United States patents has been compiled from the current numbers of the Official Gazette of the United States Patent Office. Because, as a rule, only one claim is published in the Gazette, it is not claimed that the list is complete; also, it is possible that the list may contain some patents that do not apply specifically to pulp and paper manufacture. Copies of any of the following patents may be obtained from the United States Patent Office, Washington 25, D. C., by sending twenty-five cents for each patent desired.

July 6, 1954

Alfred, Fred C., and Turner, Geoffrey B. Production of wood pulp. U. S. patent 2,683,090. Filed April 30, 1952. 8 claims. Assigned to Courtaulds Ltd. [Cl. 92-11.] Addition of 0.05–1% of copper in finely divided form either in the digester or in the liquor circulation system of a sulphite digester is claimed to increase the pulp yield and reduce formation of calcium sulphate scale.

Claff, Chester, E., and Moeller, Carl A. Machine for making reinforced webs. U. S. patent 2,682,909. Filed April 26, 1950. 7 claims. Assigned to M. B. Claff & Sons, Inc. [Cl. 154-1.7.] Cardboard web for shoe box covers is slit on the edge, adhesive-coated cord inserted in the slit and the cover paper applied to the board by this machine.

Crary, Jay D. Handled carton. U. S. patent 2,682,990. Filed Jan. 3, 1950. 2 claims. Assigned to Paper Strap Inc. [Cl. 229-37.] Strap handle made from folded paper is secured to end flaps so that when the carton is closed and the flaps sealed, the handle is bound between the flaps.

Eckert, Clarence R., and Bettoli, Phillip S. Coated fibrocement product and process of making same. U. S. patent 2,683,096. Filed Feb. 6, 1952. 15 claims. Assigned to The Ruberoid Co. [Cl. 117-70.] Coating composition using aluminum hydrate, orthophosphoric acid and pigment is claimed durable and weather resistant and requires less heat for baking.

Evans, Everett I., Henderson, John, and Swank, Claude V. General purpose protective dressing. U. S. patent 2,682,873. Filed July 30, 1952. 4 claims. Henderson's and Swank's interests assigned to Johnson & Johnson. [Cl. 128-156.] Large pad dressing comprises a gauze face sheet, layers of absorbent cellulosic material, and an outer cover of water-repellent material bound around the edge to the gauze face.

Forman, William O. Chipping cutter construction. U. S. patent 2,682,996. Filed Jan. 25, 1951. 5 claims. Assigned to Fitchburg Engineering Corp. [Cl. 241-239.] Chipper knives mounted in a drum are opposed by a bed knife for complete chipping of logs, branches, and twigs. Spring-loaded feed plate carries material up to the chipper blades.

Hoeflich, Victor T. Paper hat or cap. U. S. patent 2,682,668. Filed Oct. 3, 1950. 4 claims. [Cl. 2-209.3.]

Howdle, Frederic E., and Jochem, Theodore B. Paper break control device. U. S. patent 2,683,195. Filed Oct. 14, 1950. 13 claims. Assigned to Cutler-Hammer, Inc. [Cl. 200-61.18.] Spring-loaded shoes detect web breaks and open the circuit to stop the printing press.

Infanger, Arthur W. Machine for screening paper stock. U. S. patent 2,682,811. Filed Sept. 23, 1952. 6 claims. Assigned to The Cowles Co. [Cl. 92-34.] Flexible connection between the drive shaft and the hub to which the scraper blades are attached allows the blades to make adjustment for slight irregularities in the circular screen plate.

Jackson, Donald R. P. Packet. U. S. patent 2,682,989. Filed Jan. 6, 1950. 1 claim. Assigned to Molins Machine Co., Ltd. [Cl. 229-16.] Blank for block-ended packet is slit diagonally at the corners to eliminate bunching of the side folds.

Jones, Dwight E. Circulator-disintegrator. U. S. patent 2,682,810. Filed May 20, 1952. 12 claims. Assigned to E. D. Jones & Sons Co. [Cl. 92-26.] Disintegrator unit comprises concentric disks with the inner disk rotated at high speed to disintegrate pulp and the outer disk rotated at slower speed to provide circulation within the pulper vat.

Mathewson, Wilfred F. Pulp screen. U. S. patent 2,682,812. Filed May 20, 1952. 16 claims. Assigned to Matheson Machine Works, Inc. [Cl. 92-35.] Concentric slotted cylinders are rotated at slightly different speeds and a clearing blade is passed through the slots at intervals to remove accumulated fiber.

Mayer, Otto. Paper hat. U. S. patent 2,682,666. Filed Jan. 31, 1952. 4 claims. [Cl. 2-175.]

Piazze, Thomas E. Container making machine. U. S. patent 2,682,910. Filed Sept. 5, 1952. 21 claims. Assigned to Continental Can Co., Inc. [Cl. 154-42.] Heat-sealable material in tubular form is severed into bag lengths and the end of the bag subjected to radiant heat to produce a bead seal.

Reynolds, Walter F., Jr. Absorbent cellulosic products. U. S. patent 2,683,087. Filed Feb. 10, 1948. 6 claims. Assigned to American Cyanamid Co. [Cl. 92-3.] Feel and absorbency of paper towels is improved by the addition of a surface active agent produced by reacting ethylene oxide and octadecylamine.

Reynolds, Walter F., Jr. Soft bibulous sheet. U. S. patent 2,683,088. Filed June 10, 1952. 8 claims. Assigned to American Cyanamid Co. [Cl. 92-3.] Kraft pulp treated with a product formed by reacting a fatty acid (tall oil may be used) with monoethanolamine, then with ethylene oxide in the presence of an alkali catalyst is claimed to form a soft absorbent sheet.

Reynolds, Walter F., Jr. Bibulous sheet. U. S. patent 2,683,089. Filed June 10, 1952. 11 claims. Assigned to American Cyanamid Co. [Cl. 92-3.] Very similar to U. S. patent 2,683,088. See abstract above.

Ringler, William A. Handle for carriers. U. S. patent 2,682,-972. Filed June 13, 1950. 2 claims. Assigned to The Gardner Board and Carton Co. [Cl. 220-105.] Wire handle for paperboard bottle carrier.

Scofield, Gilbert J. Paper machine suction box cover. U. S. patent 2,682,813. Filed July 27, 1950. 4 claims. [Cl. 92-51.] Rows of overlapping holes form a continuous channel to provide increased suction area and decreased friction area and stronger construction than that of conventional covers.

Smith, William T., Euverard, Maynard R., and Callahan, Francis P., Jr. Rupture tester for sheet materials. U. S. patent 2,682,769. Filed June 6, 1950. 5 claims. Assigned to Interchemical Corp. [Cl. 73-102.] Modified Mullen tester incorporates a mirror mounted on a cam in contact with the sample surface and a light source impinged on the mirror and reflected to a suitable scale to measure the degree of deflection.

Spiess, Newton E., Jr. Container for frozen products. U. S. patent 2,682,987. Filed Dec. 4, 1948. 2 claims. Assigned to National Dairy Research Laboratories, Inc. [Cl. 229-14.] Panel of metal foil is incorporated so that one wall of the container may be removed to expose the foil for improved thermal conductivity in contact with the refrigerated surface.

Van Rosen, Robert E., and Ringler, William A. Picnic carrier. U. S. patent 2,682,988. Filed Nov. 27, 1951. 8 claims. Assigned to The Gardner Board and Carton Co. [Cl. 229-14.] Waterproofed carton within an outer carton makes a double-walled container in which beverages with ice may be transported. Unit is designed for one or a limited number of uses.

Whitehead, Earl B. Carton. U. S. patent 2,682,949. Filed Sept. 13, 1950. 1 claim. Assigned to Atlantic Carton Corp. [Cl. 206-46.] Carton for thermos bottle liner employs flaps folded inwardly to position and hold bottle out of contact with the carton walls.

July 13, 1954

Bailey, Waldo S. Log loader for vehicles. U. S. patent 2,683,541. Filed Nov. 9, 1953. 2 claims. Assigned 33 1/3% to Kenneth Maxon and 33 1/3% to Irving W. Montgomery. [Cl. 214-77.] L-shaped arms mounted on the side of a truck and actuated by hydraulic cylinders are used to elevate logs to the top of the load.

Booth, Frank. Method of making acid-resisting, microporous material. U. S. patent 2,683,400. Filed May 27, 1949. 1 claim. Assigned to The British Fibrak Separator Co. Ltd. [Cl. 92-39.] Impregnation of fibrous battery separator sheets with phenol-formaldehyde resin in aqueous solution, then polymerizing the resin to form controlled pore size is claimed.

Briggs, Ben T., and Schlosser, Paul H. Preparation of alkali

cellulose. U. S. patent 2,683,710. Filed April 4, 1950. 4 claims. Assigned to Rayonier, Inc. [Cl. 260-233.] Pulp sheets for caustic steeping are scored or slit to prevent warping and buckling when the caustic solution is admitted to the steeping press.

Dobrolet, Michael. Pleated filter element. U. S. patent 2,683,537. Filed June 11, 1949. 3 claims. Assigned to Fram Corp. [Cl. 210-169.] Method of pleating filter paper element for radial arrangement around a core tube.

Jenney, Ray S. Packaging machine. U. S. patent 2,683,557. Filed Dec. 23, 1950. 19 claims. Assigned to Kellogg Co. [Cl. 226-16.] Articles to be packaged are assembled in layers in a form and the carton slipped down over the completed form, then the filled carton inverted and the form removed.

Kasten, Walter. Filter. U. S. patent 2,683,536. Filed March 27, 1950. 5 claims. Assigned to Bendix Aviation Corp. [Cl. 210-167.] Pleated resinous impregnated filter paper is mounted in a holder so that back washing the filter carries particles downward from the filter and out the entrance port at the bottom.

Kindseth, Harold V., and Hopkins, Frank L. Pasting mechanism for bag closing and sealing machines. U. S. patent 2,683,435. Filed March 10, 1951. 6 claims. Assigned to Bemis Bro. Bag Co. [Cl. 118-1.] One end of the paste reservoir is formed by the applicator roll and its associated doctor blade which controls the amount of paste applied to the dauber shoes.

Müller, Hans F. Method for the preparation of fusible lignin resins. U. S. patent 2,683,706. Filed May 31, 1950. 16 claims. Assigned to Institut International Financier. [Cl. 260-124.] Spent sulphite lignin or other lignin is treated with sodium hydroxide, dried, redissolved and precipitated with mineral acid. This lignin is suitable for use in molding compounds.

Rice, Curtis B. Container adapted for food products. U. S. patent 2,683,561. Filed Nov. 10, 1950. 7 claims. Assigned to Sutherland Paper Co. [Cl. 229-23.] Container especially for bakery products requiring further cooking comprises separable tray and cover which are held together by engagement of tongues in slotted flaps.

Smith, John W. Method and apparatus for applying rip strips to wrapping sheets. U. S. patent 2,683,401. Filed Aug. 17, 1951. 25 claims. Assigned to Battle Creek Bread Wrapping Machine Co. [Cl. 93-1.] Tear strip is cut from across the end of a wide roll and the strip applied to a sheet of wrapping material cut from a web.

Wauda, George E. Dispensing carton. U. S. patent 2,683,529. Filed Sept. 29, 1952. 3 claims. Assigned to Marathon Corp. [Cl. 206-58.] Tab cut from cover flap of wax paper carton and joined by fracture line to the cover is used as a seal and to facilitate opening without coming in contact with cutter blade.

Williamson, Hilding V., and Hampel, Clifford A. Nonexplosive chlorine dioxide hydrate composition and process for producing same. U. S. patent 2,683,651. Filed Jan. 17, 1952. 11 claims. Assigned to Cardox Corp. [Cl. 23-152.] Chlorine dioxide hydrate is produced by bubbling a mixture containing the gas through water at 1 °C., then seeding the solution to cause crystals of hydrate to separate. These crystals are filtered, pressed into cakes, and shipped and stored at 0 to −20 °C.

July 20, 1954

Currie, Grover C., Dans, Bernard D., Wilkins, Louis F., and Dunn, Maurice B. Carton feeding apparatus for article cartoning machines. U. S. patent 2,683,959. Filed June 25, 1951. 14 claims. Assigned to Dacam Corp. [Cl. 53-91.] Positive carton feed to replace gravity feed in packaging machine.

Dick, George M. Bark-removing drum having welded hoop construction. U. S. patent 2,684,092. Filed Dec. 30, 1948. 3 claims. Assigned to Ingersoll-Rand Co. [Cl. 144-208.] Hoops contain tapered lateral fingers which are welded to longitudinal staves.

Dolman, Henry J. Transfer mechanism for feeding opened bags to a bag filling apparatus. U. S. patent 2,684,191. Filed Jan. 29, 1951. 4 claims. Assigned to Consolidated Packaging Machinery Corp. [Cl. 226-49.] Bags are removed from a magazine by an arm equipped with sucker elements, then transferred to a second pair of arms likewise equipped, which open the bag and position it over the filling nozzle.

Frankenstein, William P. Carton. U. S. patent 2,684,194. Filed May 23, 1947. 22 claims. [Cl. 229-34.] Hollow walls are formed which may be filled with insulation to make this container suitable for frozen foods.

Hart, Harry H. Papermaking machine. U. S. patent 2,684,019. Filed Nov. 14, 1950. 4 claims. Assigned to The Pusey & Jones Corp. [Cl. 92-44.] A hood to apply positive pressure above the entire fourdrinier wire, is claimed to deliver a stronger sheet containing less water from a shorter wire and with reduced wear on the wire. The hood is sealed at the slice and the lump breaker roll and by a flexible sliding seal along the deckle.

Keeler, Frederick A. Divisible carton. U. S. patent 2,684,178. Filed Feb. 23, 1950. 4 claims. [Cl. 220-107.] Shipping container forms two sealed compartments easily separable into consumer-size units.

Peyrebrune, Henri E., and Pasquinelli, Bruno B. Sheet stacking device. U. S. patent 2,684,241. Filed March 22, 1950. 8 claims. Assigned to Miehle Printing Press and Manufacturing Co. [Cl. 271-68.] Finger depresses cut portion of the blank from cutting and creasing press into cut portion of blank below, thus locking the blanks together to facilitate stripping waste.

Ross, Valentine A. Laminated paperboard sheet material. U. S. patent 2,684,314. Filed June 30, 1950. 10 claims. Assigned to Chicago Cardboard Co. [Cl. 154-46.] Laminated paperboard floor covering impregnated with melamine resin is passed between rolls to form closely spaced creases which eliminate tendency to curl and give the sheet a quilted appearance.

Warshaw, Nathan. Laminated gummed tape. U. S. patent 2,684,316. Filed Oct. 31, 1951. 7 claims. Assigned to Atlantic Gummed Paper Corp. [Cl. 154-53.6.] Adhesive between plies is confined to narrow bands to avoid unequal strains on the plies due to sharp bending of the tape.

Wilson, William S., and Bump, Albert H. Sizing paper and product. U. S. patent 2,684,300. Filed May 13, 1948. 6 claims. Assigned to Monsanto Chemical Co. [Cl. 92-3.] Addition of a maleic anhydride-rosin reaction product to rosin beater size is claimed to increase the effectiveness of the rosin size.

Zettel, Joseph H. Brush roll apparatus for opening and tufting fibrous materials and mixing the fibers with binders. U. S. patent 2,684,206. Filed April 5, 1948. 7 claims. Assigned to Johns-Manville Corp. [Cl. 241-84.] Brush rolls operating within a drum separate asbestos or other fibrous material and may be used to mix resins or the like with the fibers.

Zinn, Julius A., Jr. Method for application of a wax coating to cartons. U. S. patent 2,684,308. Filed Feb. 24, 1950. 2 claims. [Cl. 117-64.] Milk cartons are immersed in a wax bath, then drained and carried through a cooling zone to set the coating.

July 27, 1954

Aquino, Salvatore A. Paperboard shipping carton for individual articles such as scissors. U. S. patent 2,684,758. Filed Oct. 8, 1952. 3 claims. Assigned to The Hinde & Dauch Paper Co. [Cl. 206-46.] Wraparound carton for a single pair of scissors.

Brunsing, Rex L. Method of shipping lettuce and of preparing lettuce and the like for shipment. U. S. patent 2,684,097. Filed June 5, 1951. 5 claims. [Cl. 99-193.] Lettuce or the like is packed in the field in containers with small holes in the side, then placed in vacuum chambers to lower temperature by evaporative cooling for transport in a refrigerated car.

Freeman, Claude C. Package with integral handle. U. S. patent 2,684,759. Filed April 9, 1951. 2 claims. Assigned to Container Corporation of America. [Cl. 206-47.] Sleeve-type can carrier modified with finger slots in upper wall. Open-top article such as a tumbler is placed between cans.

Gerrish, Herbert C. Bag opener. U. S. patent 2,684,807. Filed Dec. 29, 1950. 1 claim. [Cl. 229-66.] Tear string in the front wall of potato chip bag makes circular opening for easy access to contents.

Hickin, Robert J. Carton blank setting-up mechanism. U. S. patent 2,684,616. Filed May 2, 1951. 4 claims. Assigned to The Ohio Boxboard Co. [Cl. 93-36.] Arms actuated by a cam force warped blanks into registration with the plunger and cavity of this setup mechanism.

Hofe, George W. von. Label-applying mechanism. U. S. patent 2,684,775. Filed Aug. 14, 1950. 9 claims. Assigned to New Jersey Machine Corp. [Cl. 216-21.] Thermoplastic coated labels are applied to bottles made of polyethylene by this device which allows a certain amount of deformation or completely collapses the side wall of the bottle before the label is applied.

Kraus, John W. Shipping and dispensing carton. U. S patent 2,684,792. Filed April 1, 1950. 1 claim. [Cl. 222-457.] Flap of carton for small parts is hinged to form a hopper front on the carton, thereby eliminating the transfer of parts to a special bin.

Lee, Charles A. Flow control apparatus. U. S. patent 2,684,690. Filed Oct. 1, 1949. 14 claims. Assigned to Paper Patents Co. [Cl. 137-599.] Vanes mounted in the throat of this spreader device encompass a divergence angle between 3 and 15° and are curved at the upstream end and straight at the downstream end.

Pearce, Lewis C. Machine for interleaving folded sheet material. U. S. patent 2,684,848. Filed Aug. 10, 1949. 23 claims. Assigned to The Pearce Development Co. [Cl. 270-57.] Items such as a greeting card and the associated envelope are collated and assembled in groups for delivery from the machine.

Ruau, Felix F. Manufacture of plugs for cigarettes. U. S. patent 2,684,614. Filed March 3, 1952. 5 claims. Assigned

to Molins Machine Co. Ltd. [Cl. 93-1.] Continuity of individual layers of cellulose filter material within a plug is controlled to prevent loss of material from the plug and consequent rejects.

Vogt, Clarence W. Apparatus for and method of combining enwrapments. U. S. patent 2,684,613. Filed Dec. 10, 1948. 12 claims. [Cl. 93-1.] Bags are fastened to tapes by thermoplastic or thermosetting adhesive for passage through filling or other equipment after which the tape may be removed or severed and utilized in the bag sealing operation.

August 3, 1954

Armstrong, Bruce. Mechanism for processing vegetable fibers. U. S. patent 2,685,108. Filed Aug. 22, 1952. 6 claims. Assigned to Jackson & Church Co. [Cl. 19-5.] Opposed plates containing concentric rows of overlapping teeth and with one of the plates driven at high speed subjects fibers to repeated bending action especially suited to separating bast fibers from pith.

Bunzl, Hugo. Filter plug for cigarettes. U. S. patent 2,685,-344. Filed June 14, 1950. 4 claims. Assigned to Cigarette Components Ltd. [Cl. 183-45.] Strand of cotton is wrapped in a strip of stiff paper and the paper formed into a tube which is then overwrapped with cigarette paper and sealed.

Caster, Irving. Folding shoe box. U. S. patent 2,685,402. Filed Aug. 5, 1952. 1 claim. [Cl. 229-52.]

Crosby, William H. Collapsible disposable container. U. S. patent 2,685,399. Filed Feb. 12, 1951. 6 claims. [Cl. 229-22.] Heavy waxed paper or board is folded to make this bottle structure.

Ferrari, Ernest R. Method for splitting or resawing insulating board. U. S. patent 2,685,311. Filed Nov. 16, 1951. 4 claims. [Cl. 144-309.] Division of U. S. patent 2,664,923 (Jan. 5, 1954) concerned with the application of lubricating fluid to the band saw blade while cutting insulation boards.

Glazer, Meyer, and Byrum, James E. Shirt wrapper and collar support. U. S. patent 2,685,403. Filed Dec. 18, 1951. 2 claims. Assigned to Princess Anne Cartons, Inc. [Cl. 229-87.]

Guyer, Reynolds. Cover for bottle carriers. U. S. patent 2,685,401. Filed Sept. 22, 1951. 2 claims. Assigned to Waldorf Paper Products Co. [Cl. 229-43.] Molded pulp cover fits bottle carrier to prevent entrance of light.

Haase, Anthony V. von. Carton closing mechanism. U. S. patent 2,685,158. Filed Sept. 2, 1950. 12 claims. [Cl. 53-138.] Cartons with paired cover sections, hinged on each side, are closed by this machine.

Hood, Clay M. Method of preparing blanc fixe. U. S. patent 2,685,499. Filed Dec. 21, 1950. 4 claims. Assigned to Eastman Kodak Co. [Cl. 23-122.] Introduction of barium chloride into sodium sulphate in a zone of controlled turbulence and sulphate ion content is claimed to produce barium sulphate of uniform particle size and color.

Jenner, George T. Container for a number of articles. U. S. patent 2,685,366. Filed April 7, 1950. 2 claims. Assigned to The British Drug Houses Ltd. [Cl. 206-65.] Zig-zag insert partitions container to position small articles such as ampoules.

Lighthall, Albert C., and Anderson, Arthur B. Lignocellulose board. U. S. patent 2,685,529. Filed June 15, 1949. 7 claims. [Cl. 106-163.] Water-repellent hardboard with high flexural strength is made by incorporation of 33–50% of defiberized wood from pine stumps, knots, etc. (which contain a high percentage of extractives), along with the normal wood or other cellulosic material in the furnish.

Lindblad, Karl R. Method of screening fibrous suspensions. U. S. patent 2,685,235. Filed Oct. 15, 1948. 1 claim. Assigned to Svenska Cellulosa Aktiebolaget. [Cl. 92-36.] Unbalanced drive shaft of this screening drum causes the drum to vibrate and rotate in the same direction as the flow of pulp in the screen vat.

Linehan, James W. Mulching paper. U. S. patent 2,685,150. Filed July 25, 1950. 1 claim. Assigned to Crown Zellerbach Corp. [Cl. 47-9.] Mulching paper made from creped kraft holds more oil impregnant and resists tearing during laying.

MacArthur, John E., Jr. Carton reclosure. U. S. patent 2,685,400. Filed Feb. 11, 1949. 6 claims. Assigned to General Motors Corp. [Cl. 229-43.] Carton flaps are provided with tabs which lock under other flaps for carton reclosure.

Schadler, Max L. Drier cylinder, particularly for papermaking machinery. U. S. patent 2,685,139. Filed Oct. 21, 1950. 6 claims. Assigned to J. M. Voith G. m. b. H. [Cl. 34-124.] Drier heads are made in two sections comprising an annular ring and a central bearing portion. The central bearing portions are connected by a tubular member which absorbs the strains normally transmitted to the shell.

Spear, Donald R. High wet strength paper and its preparation. U. S. patent 2,685,508. Filed Dec. 1, 1950. 4 claims. Assigned to Eastman Kodak Co. [Cl. 92-21.] Paper suitable for photographic purposes is made by addition of melamine-formaldehyde resin and oxidized guar to the pulp slurry prior to sheet formation.

Stinchfield, John C., and Kaulakis, Frank. Coated paper and process of making. U. S. patent 2,685,538. Filed Jan. 16, 1946. 7 claims. Assigned to S. D. Warren Co. [Cl. 117-155.] Butadiene-styrene or similar elastomer used as the adhesive in a paper coating composition is claimed to impart water resistance, flexibility, and gloss to the sheet.

Stinchfield, John C., and Kaulakis, Frank. Mineral-coated paper and composition therefor. U. S. patent 2,685,571. Filed Feb. 15, 1949. 6 claims. Assigned to S. D. Warren Co. [Cl. 260-8.] Copolymerized butadiene-styrene or similar elastomer is incorporated in calcium carbonate coating composition to protect carbonate during lithographic printing and act as the adhesive in the coating.

August 10, 1954

Arneson, Edwin L. Knockdown box. U. S. patent 2,686,001. Filed Nov. 22, 1950. 1 claim. Assigned to Morris Paper Mills. [Cl. 229-34.] Tray-type container with inwardly sloping side walls.

Berke, Aaron. Receptacle with detachable compartments. U. S. patent 2,686,000. Filed Aug. 21, 1951. 5 claims. [Cl. 229-28.] Shipping container made up of individual cartons each of which may be severed as a sealed unit.

Black, Andrew R. Fiber treating machine. U. S. patent 2,685,826,. Filed April 3, 1950. 10 claims. [Cl. 92-20.] Defibering unit mounted on the wall of a vat comprises a skeleton rotor and stator with pulp drawn into the center of the rotor and passing out between the bars of the stator. Circulation is directed by vanes within the vat and a shield around the defibering unit.

Bruce, John K., and Davis, Thomas H. Container handling equipment. U. S. patent 2,685,975. Filed April 3, 1950. 21 claims. Assigned to Bruce Engineering Corp. [Cl. 214-304.] Empty cans are removed from their containers by this device which holds the cans against the under side of a conveyor by means of a magnet mounted above the conveyor.

Buckman, Stanley J., and Meals, Robert N. Protection of paper stock against slime. U. S. patent 2,686,119. Filed Feb. 9, 1950. 10 claims. Assigned to Buckman Laboratories, Inc. [Cl. 92-3.] Slime and bacteria are controlled by the addition of an organic mercury compound (e.g., hydroxyphenylmercuric acetate) and a trichlorophenol in very small amounts.

Clark, Carleton L., and Vicario, Carlo. Deaerating a suspension of cellulosic fibers. U. S. patent 2,685,937. Filed Feb. 6, 1952. 6 claims. Assigned to The Rotareald Corp. [Cl. 183-2.5.] Control device for regulating level in deaerating tank by throttling only a few nozzles in the system.

Curtis, Russell H. Filter element. U. S. patent 2,685,969. Filed July 13, 1949. 1 claim. Assigned to Hawley Products Co. [Cl. 210-169.] Molded pulp filter unit impregnated with wet-strength resins is cylindrical in shape with fluted side walls and retained in a metal or plastic casing.

Druth, Joseph S. Wardrobe container. U. S. patent 2,685,-962. Filed Aug. 4, 1952. 1 claim. Assigned to Chippewa Paper Products Co., Inc. [Cl. 206-7.] Corrugated board container made from two telescoping sections and reinforced with wood frames.

Fahrni, Fred. Process for manufacturing a composite wooden board. U. S. patent 2,686,143. Filed Nov. 24, 1945. 11 claims. [Cl. 154-132.] Board is made from wood waste and a binder material in which a coarse core layer is sandwiched between layers made from fine shavings and a high percentage of binder to form smooth, dense surface layers.

Forrer, Homer W. Bottle carrier. U. S. patent 2,685,999. Filed Oct. 2, 1950. 2 claims. Assigned to Atlanta Paper Co. [Cl. 229-28.] Bottle carrier serves as the partition element in the shipping case.

Forrer, Homer W. Bottle carrier. U. S. patent 2,686,003. Filed Sept. 15, 1950. 2 claims. Assigned to Atlanta Paper Co. [Cl. 229-52.] This is very similar to U. S. patent 2,685,999; see abstract above.

Gray, Kenneth R. Improved refined wood pulp and a method of improving it. U. S. patent 2,686,132. Filed July 14, 1950. 14 claims. Assigned to Rayonier, Inc. [Cl. 106-163.] An oil-soluble ethylene glycol monoether of aliphatic alcohol added during shredding or viscose processing reduces scum formation and foaming and improves the characteristics of the viscose.

Hawkes, John A., and Billing, Joseph. Production of cellulose. U. S. patent 2,686,102. Filed March 1, 1950. 5 claims. Assigned to British Celanese Ltd. [Cl. 8-121.] Cotton linters are purified for production of cellulose esters or ethers by boiling in dilute caustic, bleaching in acid hypochlorite, then purification in a second strong caustic solution.

Hyman, Jerome. Combination mailing and return envelope with pullout for postal inspection. U. S. patent 2,686,005. Filed Sept. 15, 1952. 1 claim. Assigned to The Rockmont Envelope Co. [Cl. 229-73.]

Inman, William H. Tapered collapsible carton. U. S. patent 2,686,002. Filed April 30, 1953. 3 claims. Assigned to Bloomer Bros. Co. [Cl. 229-39.] Ice cream carton.

Latham, Henry H., and Morton, Joseph R. Process of loading cellulosic fibers. U. S. patent 2,686,121. Filed July 7, 1948. 15 claims. Assigned to Morton Chemical Co. [Cl. 92-21.] Method of charging fibers with cationic charge, then adsorbing the resins or latex on the charged fiber is claimed.

Marshall, Harry B., and Sankey, Charles A. Alkaline pulping of lignocellulose in the presence of oxygen to produce pulp, vanillin, and other oxidation products of lignin substance. U. S. patent 2,686,120. Filed Jan. 14, 1952. 5 claims. Assigned to The Ontario Paper Co. Ltd. [Cl. 92-9.] Wood or other cellulosic material is cooked under alkaline conditions in the presence of finely divided oxygen gas to produce oxidation products of lignin, including vanillin, during the pulping process.

Mason, Veyne V. Sheet material pelletizing apparatus and method. U. S. patent 2,685,827. Filed Feb. 5, 1951. 20 claims. [Cl. 93-1.] Hand-operated device to form paper pellets for use in oil filters.

Mason, Veyne V., and Glaze, Herbert L. Formation of pellets from sheet material. U. S. patent 2,685,828. Filed Feb. 5, 1951. 28 claims. Glaze's interest assigned to Mason. [Cl. 93-1.] Automatic machine to form paper pellets for use in oil filters.

Mobley, Edwin H. F. Carton closing machine. U. S. patent 2,685,768. Filed Sept. 15, 1951. 9 claims. Assigned to Bloomer Bros. Co. [Cl. 53-44.] Cover of cellular paperboard egg carton is closed by bars arranged above the conveyor with final locking action provided by a depressor bar actuated by a solenoid. Gummed paper seal is applied across locked joint.

Novak, Izador J. Refinement of asbestos. U. S. patent 2,685,825. Filed May 28, 1949. 1 claim. Assigned to Raybestos-Manhattan, Inc. [Cl. 92-20.] Asbestos is dispersed in water by addition of organic surface active detergent, then the slurry screened to remove debris.

Reiss, Irwin A. Bag or sack. U. S. patent 2,686,004. Filed July 12, 1951. 1 claim. [Cl. 229-55.] Reinforcing panel added to the front and back of paper bag and through which hand holds are provided.

Sawyer, Edward E. Preparation of resin-bearing fibrous pulp. U. S. patent 2,686,141. Filed June 29, 1951. 7 claims. Assigned to Keyes Fibre Co. [Cl. 154-101.] Dry fiber and resin enter a mixing chamber past oppositely charged screens and the resin-bearing fibers settle out onto a forming wire or into a storage bin. Natural or synthetic fibers and water-soluble resins unsuited to wet forming may be used.

Seiferth, Oscar E. Package. U. S. patent 2,686,129. Filed April 12, 1950. 7 claims. Assigned to Oscar Mayer & Co., Inc. [Cl. 99-174.] Aluminum foil tray comprises package in which the product may be cooked.

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Bridge, Adam E., and Gibson, Albert G. Paper machinery. U. S. patent 2,686,460. Filed Feb. 23, 1950. 8 claims. Assigned to The Black-Clawson Co. [Cl. 92-27.] Working edge of refiner bars for jordans are heated by induction to the desired temperature, quenched with oil, and the retaining edge heated in like manner to produce the desired toughness. Uniformity of treatment from bar to bar is claimed for the device.

Farber, Eduard. Process of impregnating and drying wood and composition therefor. U. S. patent 2,686,741. Filed Dec. 18, 1952. 16 claims. Assigned to The Fine Hardwoods Assoc. [Cl. 117-147.] Urea-hydroxyacetic acid solution is claimed to reduce shrinkage upon drying of wet veneer to between 1 and 3%.

Fisher, Harry R. Carton and case cutter. U. S. patent 2,686,-360. Filed Dec. 6, 1952. 6 claims. [Cl. 30-2.] Hand cutter device to remove tops from corrugated containers and the like.

Guyer, Reynolds. Egg shipping case. U. S. patent 2,686,628. Filed Jan. 2, 1951. 1 claim. Assigned to Waldorf Paper Products Co. [Cl. 229-23.]

Harney, Donald N. Binding tape for the edges of mesh fly swatters and the like. U. S. patent 2,686,746. Filed June 25, 1951. 3 claims. Assigned to E. W. Twitchell, Inc. [Cl. 154-53.6.] Strip of creped kraft with layer of cellulose wadding attached on the inside.

Heritage, Clark C., and Thomas, George W. Method of manufacturing acoustic fiberboard by perforating wet fiber mat. U. S. patent 2,686,461. Filed Sept. 23, 1948. 9 claims. Assigned to Wood Conversion Co. [Cl. 92-39.] Pins forced through a perforated platen into a wet mat are used to make clean holes in acoustic insulating board.

Hornbostel, Lloyd. Automatic deckle edge separating press roll section. U. S. patent 2,686,463. Filed March 11, 1948. 8 claims. Assigned to Beloit Iron Works. [Cl. 92-49.] Deckle trim is doctored from the press roll for reuse in the system.

Howard, Wilford. Machine for producing corrugated paper. U. S. patent 2,686,555. Filed Oct. 6, 1952. 6 claims. Assigned to Central Fibre Products Co., Inc. [Cl. 154-31.] Quadrant-shaped shower for treating the under side of the web and hood covering the upper steam shower is claimed to hold heat and moisture in the web with improvement in operating speeds.

Inman, William H. Collapsible carton. U. S. patent 2,686,629. Filed April 30, 1953. 8 claims. Assigned to Bloomer Bros. Co. [Cl. 229-39.] Automatic setup carton is easily opened and reclosed by the user.

Kohn, Earl J., and Venezky, David L. Electrochemical paper and method of preparing same. U. S. patent 2,686,858. Filed Oct. 24, 1950. 14 claims. [Cl. 204-2.] Electrolytic recording sheet is made by impregnating wet-strength rag or sulphite paper with solutions to form an insoluble benzidine salt in the sheet, then impregnating the sheet with an electrolyte such as ammonium chloride.

Lee, Filemon T. Paper shredder and press. U. S. patent 2,686,466. Filed May 15, 1951. 3 claims. [Cl. 100-97.] Paper shredder for office use utilizes shredder rolls made up of overlapping disks with feed control through an adjustable throat above the rolls.

McElwee, Joseph E. Carton with locking slide and tray. U. S. patent 2,686,627. Filed April 11, 1951. 2 claims. Assigned to The Ohio Boxboard Co. [Cl. 229-19.] Tray-type carton with sliding sleeve cover.

Prevost, Bruno E. Synchronized stock control device. U. S. patent 2,686,462. Filed April 24, 1951. 7 claims. Assigned to John W. Bolton & Sons, Inc. [Cl. 92-46.] Vacuum controlled device with sensing element at the couch roll increases degree of refining at the machine jordan if the vacuum is reduced and decreases degree of refining if the vacuum is increased.

Rock, Murray. Grease guard. U. S. patent 2,686,608. Filed Aug. 22, 1950. 1 claim. [Cl. 220-4.] Strip of fire-resistant paper cut to form an upstanding collar around a skillet.

Russell, Alexander. End tucker and folder mechanisms for wrapping machines. U. S. patent 2,686,393. Filed Feb. 4, 1952. 7 claims. Assigned to The Forgrove Machinery Co. Ltd. [Cl. 53-135.] Projecting ends of the banded wrapper are tucked in and folded against the end of the package by this machine.

White, Ralph V., Landis, Philip S., and Backensto, Elwood B. Sulphate process tall oil as a rust inhibitor for fuel fractions of mineral oil. U. S. patent 2,686,713. Filed Dec. 9, 1950. 7 claims. Assigned to Socony-Vacuum Oil Co., Inc. [Cl. 44-62.] Tall oil is claimed to make a very effective rust inhibitor for nonlubricating fractions of mineral oil.

Wolfe, Dexter L., and Ruddy, Earle A. Paper splicing. U. S. patent 2,686,748. Filed June 19, 1950. 8 claims. Assigned to The Institute of Paper Chemistry. [Cl. 154-100.] Vinyl acetate film is made in strip form and fused between overlapped layer of paper by means of a hot iron to produce a splice that passes through printing presses and disperses in the beater.

Zander, Nils A. Adhesive applicator for label applying machines. U. S. patent 2,686,607. Filed Aug. 11, 1951. 9 claims. [Cl. 216-45.] Glue is carried upward from the reservoir by a spirally grooved rotating cylinder which is contacted by the applicator roll that transfers the adhesive to the reverse side of the label in the label holder.

August 24, 1954

Anderegg, Frederick O. Apparatus for measuring humidity. U. S. patent 2,687,041. Filed Jan. 19, 1949. 5 claims. [Cl. 73-335.] The condition of a desiccant material within a closed space is determined by comparison of an indicator attached to the desiccant container with a scale graduated in known amounts of moisture.

Arneson, Edwin L. Method of making article carriers. U. S. patent 2,687,067. Filed March 20, 1951. 4 claims. Assigned to Morris Paper Mills. [Cl. 93-36.] Traylike carrier with central partition perforated for finger holes.

Arneson, Edwin L. Bottle carrier. U. S. patent 2,687,232. Filed Sept. 15, 1950. 2 claims. Assigned to Morris Paper Mills. [Cl. 229-28.]

Burger, Martin, and Carkhuff, Le Roy F. Method and apparatus for conditioning carton blanks. U. S. patent 2,687,069. Filed April 18, 1951. 5 claims. Assigned to General Package Corp. [Cl. 93-37.] Cooperating rotary dies prebreak and prebend the cut portions of paperboard blanks and simultaneously strip waste portions from the blank.

Chew, Albert C. Machine for handling cards and the like. U. S. patent 2,687,300. Filed April 16, 1952. 4 claims. Assigned to Hobson-Miller Machinery, Inc. [Cl. 271-11.] Cards or like items are removed from a stack and brought into contact with the printing cylinder in timed relationship.

Chidsey, Francis A., Jr. Collapsible paperboard carrier. U. S. patent 2,687,247. Filed Nov. 14, 1950. 4 claims. Assigned to Container Corporation of America. [Cl. 229-41.] Basketlike carrier formed from rectangular blank may be shipped and stored in collapsed condition and easily erected.

Frankel, Sydney. Hydraulic back gage for paper cutters. U. S. patent 2,687,011. Filed March 25, 1950. 3 claims. Assigned to E. P. Lawson Co., Inc. [Cl. 60-51.] Hydraulic system moves back gage rapidly between settings but arrives at final setting slowly to ensure the paper stack will stop at the predetermined point.

Freeman, Claude C. Can holder. U. S. patent 2,687,248. Filed Nov. 15, 1950. 7 claims. Assigned to Container Corporation of America. [Cl. 229-87.] Strip of papeboard folded to form a holder to engage two cans of different sizes.

Gastright, Frank A. Bulk merchandise dispensing machine. U. S. patent 2,687,070. Filed June 3, 1950. 4 claims. Assigned to The Queen City Manufacturing Co. [Cl. 93-53.] Automatic-bottom type cartons are erected by this machine as needed and positioned under the delivery spout to receive the dispensed product.

Gilman, Charles. Machine and method for making valve bags. U. S. patent 2,687,066. Filed June 26, 1951. 4 claims. Assigned to Kraft Bag Corp. [Cl. 93-8.]

Hansel, Sydney. Hydraulic log-barking apparatus having opposed slit-nozzles and log-aligning conveyors. U. S. patent 2,687,152. Filed Nov. 15, 1951. 19 claims. [Cl. 144-208.] Pulpwood is assembled in batches and passed through a housing where the logs are subjected simultaneously to jets from above and below.

Hollis, Robert F. Corrugator roll mounting. U. S. patent 2,687,165. Filed Oct. 8, 1951. 9 claims. Assigned to F. X. Hooper Co., Inc. [Cl. 154-30.] Interconnected hydraulic cylinders apply uniform pressure to both ends of the movable corrugating roll to prevent vibration and to produce a uniform product at all roll speeds.

Hoos, Benjamin G. Process of refining hardwood pulp. U. S. patent 2,687,352. Filed Feb. 21, 1946. 6 claims. Assigned to Brown Co. [Cl. 92-13.] Process of chemically purifying sulphite hardwood pulp (e.g., birch, beech, maple) for use in cellulose derivatives by bleaching, hot sodium hydroxide-soap digestion, and a final hypochlorite bleach.

Kimball, Benjamin M. Device for forming paper yarn. U. S. patent 2,687,299. Filed Nov. 18, 1952. 1 claim. Assigned to The Cellucord Corp. [Cl. 270-93.] Paper tape is folded in a conical former so that the edges are turned inward to make a tape of three thicknesses with greater strength and with only one side of the sheet exposed for color uniformity.

Peterson, William R. Screw-type filling machine. U. S. patent 2,687,244. Filed Dec. 15, 1948. 10 claims. Assigned to St. Regis Paper Co. [Cl. 226–48.] Horizontal filling tube with screw conveyor is adapted to filling valve bags with light, fluffy materials. Feeder conveyors force the material from the hopper down to the feed screw.

Randall, Walter H. Pack for fruit and other articles. U. S. patent 2,687,246. Filed May 27, 1950. 9 claims. Assigned to The Canal National Bank of Portland and Porter Thompson. [Cl. 229-2.5.]

Richens, Charles E. Bag cutting means. U. S. patent 2,687,-174. Filed June 8, 1951. 2 claims. [Cl. 164-58.] Serrated cutting edges sever upper and lower layers of bag tubing when said tubing is forced against the cutting edges by the striker bar which operates between the cutters and the pinch rolls.

Rinse, Jacobus. Ramie fiber separation. U. S. patent 2,687,-351. Filed Oct. 23, 1951. 3 claims. [Cl. 92-10.] Ramie is heated in a caustic solution containing 1% zinc oxide, washed with hot water, and then given an acid wash to release the fibers.

Sooy, Walter E., Sooy, Brainard E., and Kramer, Joseph. Device for handling printed sheets. U. S. patent 2,687,301. Filed May 24, 1949. 16 claims. Assigned to The Gardner Board and Carton Co. [Cl. 271-87.] Sheets are forced between supports which maintain a slight space between sheets to prevent smearing and offsetting.

Strzala, Kazimer A. Carton sealing apparatus. U. S. patent 2,687,068. Filed Dec. 12, 1950. 10 claims. Assigned to Owens-Illinois Glass Co. [Cl. 93-37.] Spring arms force the partition assembly upward within the carton so that glue is not accidentally applied to the bottom edge of the partition.

West, George T., Winters, Walter H., Odell, Malcolm J., and Stokes, Richard P. Emulsion adhesive applicator. U. S. patent 2,687,110. Filed Aug. 18, 1950. 3 claims. Assigned to Dewey and Almy Chemical Co. [Cl. 118-246.] Friction drive clutch engages to rotate adhesive applicator roll when tape is not causing rotation but allows free rotation when tape is drawn over the roll.

August 31, 1954

Armstrong, Adam E. Temperature control for driers and the like. U. S. patent 2,687,851. Filed Aug. 19, 1949. 5 claims. [Cl. 236-1.] Steam valve is controlled through a compressed air linkage by a heat-responsive bulb located in the condensate return line.

Corley, Mark H., Arvidson, Bengt A., and Barber, Ralph F. Combination sheeter and wrapping machine. U. S. patent 2,687,604. Filed Dec. 8, 1951. 3 claims. Assigned to Miller Wrapping & Sealing Machine Co. [Cl. 53-120.] Semiautomatic machine cuts sheet of wrapping for the operator, completes end folds and heat seals folded areas.

Fennell, Francis L. Bleaching of groundwood-sulphite pulp mixtures. U. S. patent 2,687,942. Filed March 19, 1951. 10 claims. Assigned to E. I. du Pont de Nemours & Co., Inc. [Cl. 8-104.] Alkalinity of the peroxide bleach is controlled to an optimum value for the mixture of groundwood and sulphite pulps.

Gray, Harry Z. Collapsible hollow wall carton. U. S. patent 2,687,839. Filed July 22, 1952. 2 claims. [Cl. 229-31.]

Innes, Robert H. Container structure. U. S. patent 2,687,-840. Filed Feb. 26, 1951. 9 claims. Assigned to Perga Containers Ltd. [Cl. 229-51.] Paperboard milk carton.

Krogel, Christopher J. Method of controlling the density of pulp insulation. U. S. patent 2,687,677. Filed March 29, 1952. 4 claims. Assigned to Western Electrical Co., Inc. [Cl. 92-39.] Wires with pulp insulation applied are passed between squeeze rolls to dewater, then over a grooved roll where a controlled amount of water is added to fluff the pulp prior to drying.

Messing, Hjalmar S. Feeding device for pulp making machinery. U. S. patent 2,687,816. Filed Aug. 16, 1951. 6 claims. Assigned to American Defibrator, Inc. [Cl. 214-17.] Chips are fed from the hopper into a horizontal screw conveyor which transports them to the vertical feed stack. A bypass equalizes steam pressure to prevent blowbacks.

Othmer, Donald F., Ricciardi, Louis G., and Smith, Warren R. Method of preparing products comprising compressed lignocellulosic materials and chemically combined soluble silicates. U. S. patent 2,687,556. Filed Jan. 5, 1951. 6 claims. [Cl. 18-55.] Dry forming process for wallboard or hardboard involves mixing about 20% of powdered lignin (e.g., Indulin A) and 6% of soluble silicate with the dry wood fiber, bagasse, etc., and subjecting the mixture in a tray or other mold to heat and pressure for 9–15 minutes.

Pete, Robert H. Bleaching of mechanical wood pulp. U. S. patent 2,687,943. Filed June 26, 1951. 8 claims. Assigned to E. I. du Pont de Nemours & Co., Inc. [Cl. 8-104.] Pretreatment of pulp with nonoxidizing calcium salt is claimed to have same results as where the pulp is given a hypochlorite bleach prior to the peroxide bleach.

Rowland, Clare B., and Christensen, Owen A. Bellows folding machine. U. S. patent 2,687,678. Filed Nov. 4, 1948. 26 claims. Assigned to General Motors Corp. [Cl. 93-1.] Hinged fold plates move inwardly simultaneously from all four sides to pleat the paper tube clamped between end heads and inflated with air pressure.

Weimer, Kenneth A. Can carrier. U. S. patent 2,687,800. Filed July 19, 1952. 1 claim. Assigned to Morris Paper Mills. [Cl. 206-65.]

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Adams, Daniel O. Plant container. U. S. patent 2,688,209. Filed Jan. 24, 1952. 9 claims. Assigned to Bird & Son, Inc. [Cl. 47-37.] Chipboard or similar material formed into a band or pot is coated with a resin to make a root impermeable layer until the coating is fractured, after which the material is readily permeable.

Boblit, Harry, Sr., Musser, Malcolm E., Boblit, Harry, Jr., and Boblit, Ronald E. Buckle-type paper folding machine. U. S. patent 2,688,482. Filed July 11, 1949. 17 claims. Assigned to A. B. Dick Co. [Cl. 270–68.] Paper sheets fed into a confined space are caused to buckle and the buckle passed through the next pair of feed rolls to form a permanent crease.

Burger, William H., Collins, Howard A., and Ruth, Howard M. Method and apparatus for making tampons. U. S. patent 2,688,163. Filed April 16, 1948. 31 claims. Assigned to International Cellulcotton Products Co. [Cl. 19-144.5.] Wood or cotton cellulose is formed into a tampon unit, the unit enclosed in a knitted web which is then severed between units and the forward end of the knitted cover tucked back into the end of the tampon body.

Fahrni, Fred. Apparatus for forming an adhesive film. U. S. patent 2,688,306. Filed Jan. 11, 1951. 10 claims. [Cl. 118-262.] Chips, shavings, or the like are alternately pressed into contact with the adhesive-coated roll and tumbled within a hopper for uniform application of adhesive.

Forrer, Homer W. Compartmented carton. U. S. patent 2,688,421. Filed April 13, 1953. 6 claims. Assigned to Atlanta Paper Co. [Cl. 220-111.] Bottle carrier.

Frankenstein, William P. Carton. U. S. patent 2,688,432. Filed April 27, 1949. 13 claims. [Cl. 229-27.] An improvement over U. S. patent 2,493,189 (Jan. 3, 1950) provides an extra lengthwise partition in this hollow-walled, knockdown carton.

Fryburger, Vernon R. Single-blank display and shipping carton. U. S. patent 2,688,396. Filed July 16, 1951. 1 claim. Assigned to The United States Printing & Lithograph Co. [Cl. 206-44.] Normal rectangular shape of the container may be altered to provide a sloping display for elongated articles such as cigars.

Haas, Edwin K. Sheet pulp feeder. U. S. patent 2,688,414. Filed April 12, 1952. 7 claims. Assigned to Eastman Kodak Co. [Cl. 214-8.5.] Pusher arm feeds pulp sheets from the top of

a bale supported on a constantly rising elevator for continuous feed to a pulper.

Hamilton, Joseph P. Container. U. S. patent 2,688,433. Filed March 18, 1952. 2 claims. Assigned to Charles Dreifus, Jr. [Cl. 229-34.] Corrugated board crate incorporates wooden nailing strips for securing top and bottom with usual nailing machines.

Jones, Rufus V. Lignin, sulfates and their production. U. S. patent 2,688,611. Filed Dec. 19, 1949. 23 claims. Assigned to Phillips Petroleum Co. [Cl. 260-124.] Chlorosulphonate is treated with a sulphur dioxide-pyridine complex beneath the surface of an inert solvent to produce lignin sulphates for use in adhesives, rubber, inks, etc.

Loeb, Joseph K., and Loeb, Leon N. Container. U. S. patent 2,688,431. Filed July 29, 1950. 1 claim. [Cl. 229-16.] Container for plant bulbs has handles formed by extension of cover flaps; front wall may be opened for display purposes.

Luebke, Jerome J. Paper machine head box. U. S. patent 2,688,277. Filed May 12, 1951. 13 claims. Assigned to Marathon Corp. [Cl. 92-44.] Curved vanes in the distribution chamber at the rear of the headbox uniformly distribute the stock laterally before said stock passes into the stilling chamber.

Nicholson, Thomas W. Log barking machine of light frame and having safety means for holding the log. U. S. patent 2,688,349. Filed Feb. 17, 1950. 5 claims. [Cl. 144-208.] Lathe-type barker contains release elements in the hydraulic system to protect the machine in the event of jamming.

Ryan, Patrick P., and Shepardson, Wilfred B. Electrically conductive resinous laminate. U. S. patent 2,688,576. Filed Dec. 21, 1949. 5 claims. Assigned to St. Regis Paper Co. [Cl. 154-43.] Carbon black is added to the resin in producing laminated products, thereby making the laminate electrically conductive and suited to electrostatic spray coating.

Schmitt, George P., and Werberig, Cornelius. Continuous method for producing thermosetting phenol-aldehyde resins. U. S. patent 2,688,606. Filed Oct. 20, 1951. 5 claims. Assigned to St. Regis Paper Co. [Cl. 260-57.] A single-stage, continuous flow, stirred tank reactor is utilized to produce resins in a continuous process with simple process control.

Showers, Robert E. Head box for paper machines. U. S. patent 2,688,276. Filed May 11, 1951. 4 claims. Assigned to Marathon Corp. [Cl. 92-44.] Honeycomb section of tubes in the throat of this headbox causes mild mixing of stock at the same time that the flow is straightened prior to leaving the slice.

Sisson, Edmond F., Cole, Richard F., and Krumbein, Jacob P. Method of separating tall oil into a fatty acid product and a rosin acid product. U. S. patent 2,688,590. Filed Dec. 13, 1947. 4 claims. Assigned to Newport Industries, Inc. [Cl. 202-52.] Vacuum distillation of tall oil is used to separate a fatty acid product which contains at least 95% fatty acids.

Suen, Tzeng J. Modified melamine resin and process for preparing the same. U. S. patent 2,688,607. Filed Dec. 11, 1951. 19 claims. Assigned to American Cyanamid Co. [Cl. 260-67.6.] Melamine and formaldehyde are reacted at a pH of 7–8, 2-aminoethylsulphuric acid and sodium hydroxide added, and the reaction continued to produce a resin useful as a wet-strength agent or for textile treatment.

Udel, Bernard. Cigarette package having opening means. U. S. patent 2,688,434. Filed May 3, 1949. 1 claim. [Cl. 229-51.] Cigarette package wrapper is notched and scored to facilitate opening of the package.

Vogt, Clarence W. Chained enwrapment. U. S. patent 2,688,435. Filed March 5, 1949. 3 claims. [Cl. 229-53.] Flaps cut from the top of bags and coated with heat-sealable adhesive are used to secure bags together for filling, etc., then released and the tabs used for sealing the bag.

Waller, Erik A. Sectional rotatable log barking drum. U. S. patent 2,688,350. Filed Jan. 22, 1951. 3 claims. [Cl. 144-208.] Sections of the drum are rotatable at different speeds to increase the barking effectiveness of the drum.

September 14, 1954

Andrew, James B. W., Jr. Textile shipping container. U. S. patent 2,689,078. Filed April 9, 1949. 2 claims. Assigned to Container Corporation of America. [Cl. 229-23.] Cover sections telescope over a two-piece liner, one wall of which folds down to facilitate packing.

Brown, Marshall A. Cup dispensing device. U. S. patent 2,689,062. Filed March 18, 1952. 3 claims. [Cl. 221-197.] Metal insert locks inside the bottom of a paper cup carton to allow removal of single cups from the carton.

Clark, James d'A., and Mottet, Arthur L. Method and apparatus for preparing crosscut fiber. U. S. patent 2,689,092. Filed May 23, 1949. 17 claims. Assigned to The Long-Bell Lumber Co. [Cl. 241-28.] Bolts of wood held in a reciprocating hopper are passed over a scoring and rotary cutting device to produce shavings or flakes which may be milled to desired size by cleavage between fibrous elements.

Daniels, Joseph S. Web drier. U. S. patent 2,689,196. Filed April 2, 1951. 9 claims. [Cl. 117-103.] Paper web coated on both sides is passed over a series of perforated drums supplied with heated air under sufficient pressure to form an air cushion under the web and prevent contact of the paper with the drums.

Ericks, Walter P. Compositions containing esters of a glycol and polycarboxylic acids and the treatment of cellulose therewith. U. S. reissue patent 23,866. Filed Jan. 14, 1954. 18 claims. Assigned to The Upson Co. [Cl. 260-29.3.] Extension of U. S. patent 2,629,701 (Feb. 24, 1953) for impregnating agent to improve dimensional stability of cellulose fibers.

Gray, Harry Z. Bottle carrier. U. S. patent 2,689,061. Filed Dec. 4, 1948. 12 claims. [Cl. 220-113.]

Hornbostel, Lloyd. Rectifier roll-cleaned, vane-type flow spreader for paper machines. U. S. patent 2,688,905. Filed March 17, 1949. 7 claims. Assigned to Beloit Iron Works. [Cl. 92-44.] Adjustable vanes in combination with a rectifier roll provide lateral distribution of stock in the paper machine headbox.

Jenkins, William E. Combined beverage carton and imbibing tube. U. S. patent 2,689,076. Filed Oct. 17, 1951. 2 claims. [Cl. 229-7.] Triangular paperboard carton and L-shaped plastic tube for beverages.

Limerick, Jack McK. Method of removing hemicellulose from wood pulp. U. S. reissue patent 23,868. Filed April 8, 1954. 4 claims. Assigned to Bathurst Power & Paper Co. Ltd. [Cl. 92-16.] Multistage caustic treatment of wood pulp is claimed to produce an 80% yield of a product which contains more than 96% α-cellulose and is suitable for the manufacture of cellulose acetate.

Main, James W. Packing and shipping container. U. S. patent 2,689,077. Filed April 25, 1952. 3 claims. Assigned to Container Corporation of America. [Cl. 229-14.] Double-walled corrugated container with the inner wall bowed inwardly to form a cushion for the contents.

Timer, Jules E. Container. U. S. patent 2,689,079. Filed Aug. 15, 1952. 1 claim. Assigned to Chippewa Paper Products Co. [Cl. 229-68.] Envelope-type container comprises several layers of corrugated board secured on the edges with stitching and closed at the top with one or more flaps.

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Bagnall, John A. Handle attaching apparatus. U. S. patent 2,689,506. Filed April 20, 1950. [Cl. 93-8.] Machine adjustable to operate on bags of various sizes, forms and applies string handles simultaneously to both sides of paper bags.

Castle, Eli N. Foldable cardboard bottle carrier. U. S. reissue patent 23,871. Filed Nov. 28, 1952. 16 claims. Assigned to The Gardner Board and Carton Co. [Cl. 220-115.]

Feigal, Richard S. Humidity measuring apparatus. U. S. patent 2,689,479. Filed Nov. 28, 1950. 12 claims. Assigned to Minneapolis-Honeywell Regulator Co. [Cl. 73-335.] Electrical circuit for connection of humidity-responsive elements of limited range into an instrument measuring a wide range.

Fortress, Fred, and White, Blanche B. Propionic acid from wood pulp waste liquor. U. S. patent 2,689,817. Filed Dec. 17, 1949. 3 claims. Assigned to Celanese Corporation of America. [Cl. 195-47.] Spent sulphite liquor is tripped of sulphur dioxide, concentrated to 20% solids and fermented with *Propionibacterium* to produce propionic acid.

Goulding, Albert, Jr., Bond, John C., Emrick, Harold W., and Krosse, John W. Apparatus for heating and cooling laminates. U. S. patent 2,689,372. Filed Nov. 24, 1950. 7 claims. Assigned to Goodyear Aircraft Corp. [Cl. 18-1.] Resin impregnated laminates are cured over large metal molds heated by an electric element in conjunction with a fan which is also used to cool the mold.

Kindseth, Harold V. Siftproof top closure for bags. U. S. patent 2,689,438. Filed Jan. 29, 1951. 4 claims. Assigned to Bemis Bro. Bag Co. [Cl. 53-16.] Adhesive is applied to the folded walls and extended to the upstanding flaps, then these flaps folded flat to form a tight seal.

Peters, Harry. Article feeding mechanism. U. S. patent 2,689,731. Filed Dec. 11, 1951. 16 claims. Assigned to The Raymond Bag Co. [Cl 271-41.] Friction elements have a multi-ply bag tube from the bottom of the pile and into engagement with a conveyor.

Tebbs, George W. Sheet separating and forwarding machine. U. S. patent 2,689,730. Filed Feb. 16, 1951. 3 claims. Assigned to Headley T. Backhouse. [Cl. 271-27.] Suction grippers mounted on an oscillating shaft engage sheet material on top of a pile and move it into contact with an associated conveyor.

Whitaker, James N. Swingable redwood-bark-peeling chisel having peeled-log-contacting guide. U. S. patent 2,689,590. Filed Sept. 27, 1952. 5 claims. [Cl. 144-208.] Flexibly mounted chisels peel the bark as the log is rotated toward the chisels; log-contacting shoes prevent gouging of the log surface.

Willits, George W. Holder. U. S. patent 2,689,643. Filed June 18, 1951. 1 claim. [Cl. 206-57.] Container for filter disks becomes dispenser through center opening top panel.

Woodard, Omar V. Log-peeling machine having cutter and log-handling carriages movable on transversely extending trackways. U. S. patent 2,689,591. Filed June 26, 1953. 4 claims. [Cl. 144-208.] Long logs are traversed and rotated while supported on wheeled dollies. Boom-mounted rotating cutter head is adjusted for depth of cut by shoes that ride on the bark.

September 28, 1954

Allen, Malcolm C., and Magill, Donald G. Fiber container with side seam opening and reclosing feature. U. S. patent 2,690,288. Filed Aug. 1, 1949. 3 claims. Assigned to American Can Co. [Cl 229-51.] Container of the metal end type is made reclosable by tucking the side opening flap under a ledge in the side wall construction.

Burger, William H., and Wheelhouse, Walter W. Fluff making apparatus. U. S. patent 2,689,985. Filed April 18, 1947. 11 claims. Assigned to Paper Patents Co. [Cl. 19-156.] A fluffed fiber for use in insulation blankets, absorbent pads or the like, is made by passing pulp, paper, or paperboard through a hammer mill, then through an attrition mill and finally through a screen of rotating bars and plates before deposition on a backing web of paper or similar material.

Claus, Paul E., Nye, William T., and Rendall, Warren C. Collapsible carrying means for receptacles. U. S. patent 2,690,289. Filed Nov. 1, 1950. 11 claims. Assigned to Gaylord Container Corp. [Cl. 229-52.] A strip with notched ends is passed through the slotted upstanding ears formed from double side walls to make a handled basket.

Dawson, Kenwood S. Fastening means for fiberboard and corrugated cartons. U. S. patent 2,690,286. Filed Dec. 19, 1950. 1 claim. Assigned to Waterbury Corrugated Container Co. [Cl. 229-35.] Locking tongue and slot interlock with a snap action.

Erskine, Frank G., and Wasyluka, Paul. Cover locking device for containers. U. S. patent 2,690,287. Filed Jan. 2, 1951. 3 claims. Assigned to Gaylord Container Corp. [Cl. 229-45.] Double end walls strengthen the locking closure of center meeting, flanged carbon covers.

Halahan, John, Aronson, Theodore F., and Lyon, Floyd A. Window envelope machine. U. S. patent 2,690,102. Filed April 12, 1950. 4 claims. Assigned to Berlin & Jones Co., Inc. [Cl. 93-61.] Window patches are cut from glassine coated with ethylcellulose and moistened with toluene to make the coating temporarily tacky. No loose edges interfere with envelope stuffing.

Halahan, Joh, Aronson, Theodore F., and Lyon, Floyd A. Blank feeding apparatus. U. S. patent 2,690,337. Filed April 26, 1950. 10 claims. Assigned to Berlin & Jones Co., Inc. [Cl. 271-62.] Envelope or similar blanks are supported on an elevator in this feeding device which incorporates auxiliary support means activated while the elevator is lowered to receive a new supply of blanks.

Hirson, Benjamin. Apparatus for reinforcing and punching sheets. U. S. patent 2,690,101. Filed May 21, 1952. 2 claims. Assigned to Strongleaf Paper Corp. [Cl. 93-1.] Disk of gummed tape is applied to sheet, then a hole is punched through both the sheet and the reinforcing.

Jones, Dwight E., and Cupston, Edward H., Jr. Refining apparatus. U. S. patent 2,690,098. Filed Sept. 18, 1952. 12 claims. Assigned to E. D. Jones & Sons Co. [Cl. 92-26.] Rotating disk is disposed between two nonrotating refining faces with one face and the disk adjustable to maintain the desired clearance on each side of the disk.

Kaiser, Edward W., and Czarnecki, John D. Method of packing adhesives in shipping containers for easy removal. U. S. patent 2,690,255. Filed Oct. 30, 1951. 15 claims. Assigned to American Can Co. [Cl. 206-84.] Metal or fiber-bodied containers lined with an organo-silicon polymer may be used for shipment of adhesive materials that would normally stick to the containers.

Leng, Franz M. Apparatus and method for producing building boards. U. S. patent 2,689,975. Filed Jan. 15, 1952. 9 claims. [Cl. 18-4.] Structural panels are produced from wood wool or excelsior which is moistened, coated with a binder such as Portland cement, the fibers distributed to a uniform thickness over a plate and a cover plate positioned and pressure applied during the curing period.

McGarvey, Alan R. Method of producing fire-resistant inorganic fiber insulation. U. S. patent 2,690,100. Filed June 24, 1950. 10 claims. Assigned to Armstrong Cork Co. [Cl. 92-61.] Similar to U. S. patent 2,690,393, with resin curing temperatures above 350°F. claimed as especially suitable.

McGarvey, Alan R. Method of producing fire-resistant insulation. U. S. patent 2,690,393. Filed June 24, 1950. 7 claims. Assigned to Armstrong Cork Co. [Cl. 92-21.] Monocalcium phosphate or the like incorporated with phenol-formaldehyde resin as a binder is added to mineral wool insulation as a fireproofing agent.

Main, James W. Compartmented shipping container. U. S. patent 2,690,285. Filed June 11, 1952. 6 claims. Assigned to Container Corporation of America. [Cl. 229-15.] Stackable, fruit shipping container features inwardly sloping end walls and a central load-bearing partition with locking lugs which engage slots in the bottom of the stacked-above container.

Reilly, Franklin J. Vacuum slice for paper machines. U. S. patent 2,690,099. Filed March 15, 1950. 2 claims. [Cl. 92-49.] Wedge-shaped nozzle extending the width of the press rolls and connected to a vacuum system is positioned adjacent the nip on the intake side to remove water expressed from the paper and felt passing between the rolls.

Shields, Albert F. Open throat box gluing machine. U. S. patent 2,690,156. Filed May 25, 1951. 12 claims. Assigned to S & S Corrugated Paper Machinery Co., Inc. [Cl. 118-11.] Glue applicator roll and reservoir mounted on movable shaft applies glue to flap of stacked blank, then moves to one side until top blank is removed from the stack.

Shuler, Fredrick A. Flexible sheetlike odor-absorbent bodies and method of producing same. U. S. patent 2,690,415. Filed Feb. 2, 1951. 3 claims. [Cl. 167-84.] Gauze web is adhesive coated, then odor-absorbent material (e.g., activated carbon or silica gel) in granular form dusted on the web.

Smith, Jesse A. B. Carbon pack. U. S. patent 2,690,343. Filed Nov. 27, 1951. 2 claims. Assigned to Underwood Corp. [Cl. 282-1.] Fan-folded carbon sheets are held together at one end by a line of stitching and a line of weakness for easy removal of the worn sheets.

Turner, William E. Yarn cone holder with locking means. U. S. patent 2,690,290. Filed April 19, 1949. 6 claims. Assigned to O. B. Andrews Co. [Cl. 229-87.] Tubular holder contains holes to receive each end of the cone and a locking tab and slit for closing.

White, Ray T. Lamp bulb package. U. S. patent 2,690,254. Filed Sept. 22, 1949. 1 claim. Assigned to The Hankins Container Co. [Cl. 206-65.] An extension of U. S. patent 2,654,472 (Oct. 6, 1953) providing a sleeve with divider as a container for two light bulbs.

Winkler, Richard, and Dünnebier, Max. Machine for the manufacture and printing of envelopes. U. S. patent 2,690,103. Filed Nov. 14, 1950. 12 claims. Assigned to Berkley Machine Co. [Cl. 93-62.] Envelope blanks are printed, folded, adhesive applied, and the complete envelope passed between pressure rolls in closely timed sequence to eliminate machine idling between blanks.

LETTERS TO THE EDITOR

Paper Machine Speeds

To the Editor, *Tappi:*

I thought I would call your attention to a slight error occurring on page 135A of the October, 1954, issue of *Tappi.* This may be merely a typographical error, but in the account of the Powell River achievement of 2000 f.p.m. speeds, the statement is made that "up until 1930 no paper machine had reached the 1000-ft. mark."

Just to clear up the record, paper was first made at a speed of 1000 f.p.m. on Oct. 23, 1920. This was done on a Bagley & Sewall fourdrinier machine at the Mosinee Paper Mills Co. plant. This is recorded in "A Chronology of Papermaking in the United States" written by Harry E. Weston and published in 1945 by the Hercules Powder Co. in their publication "The Paper Maker."

I thought you might be interested in this comment, as I hate to see our no. 3 paper machine robbed of its past glories.

H. C. Crandall, *Technical Director*
Mosinee Paper Mills Co.
Mosinee, Wis.

Citrus Boxes

To the Editor, *Tappi:*

I happened to read an article from *Modern Packaging,*

August, 1950, issue, about corrugated cardboard boxes for citrus. As a corrugated cardboard manufacturer, I am most interested in the process described.

It is said that the method has been developed by The Institute of Paper Chemistry under a program sponsored by the Fourdrinier Kraft Board Institute.

In addition, and due to the fact that the article above is now four years old, I would like to know if the method described has met with success the trial of experience and is now being applied on a large scale.

P. Bayle
Cie Marocaine des Cartons & Papiers
Port Lyautey, Morocco

To the Editor, *Tappi:*

The process referred to in *Modern Packaging* was sulphurized 0.009 corrugating material.

We have done all of the experimental work in relation to the shipment of citrus fruit in corrugated boxes. We determined before we undertook the venture that we would have to develop new substances if we were to satisfactorily and safely transport this commodity. The principal problem was to produce a corrugated box that would maintain its rigidity at high humidity. This is what sulphurized 0.009 accomplishes.

We secured patents on this material and gave them to The Institute of Paper Chemistry. They are therefore the licensing agency.

If you will write John Strange of The Institute of Paper Chemistry at Appleton, Wis., I am sure he will be glad to give you any details that you may wish regarding this process.

George B. Gibson, *Managing Director*
Fourdrinier Kraft Institute, Inc.,
New York, N. Y.

Corrosion of Evaporator Tubes

To the Editor, *Tappi:*

I am anxious to obtain some information in connection with steps which can be taken to reduce or eliminate the combined corrosion and scaling of evaporator tubes in a sulphate pulp mill. I wonder if you will be kind enough to let me have the references of any technical articles on this subject which have been published by *Tappi* or which have been presented by your members. If possible, I would like to have answers to the following questions.

1. In sulphate mills in America, is there a move to replace steel or alloy-steel evaporator tubes with stainless steel tubes in order to eliminate scaling and corrosion troubles?

2. What methods are used to eliminate scale and corrosion on the vapor side of evaporator tubes composed of steel or alloy steel in evaporators in sulphate mills?

3. Is the scaling and corrosion which take place on the vapor side of mild steel tubes in an evaporator in a sulphate mill caused by the formation of iron sulphide due to the attack on the steel by organic sulpho compounds? If so, is there an alloy steel which will stand up to the attack or is there any established method of preventing vapor side scaling and corrosion?

4. If stainless steel tubes are advocated for evaporators in sulphate mills, what quality and gage of stainless steel is recommended?

F. A. Renwick
Tribeni Tissues, Ltd.
Calcutta, India

To the Editor, *Tappi:*

Searching the latest *Tappi* bibliographies does not produce any late papers on corrosion directly pertaining to evaporators, however, Carl Gustave Van Essen (*Tappi* 33, No. 7: 14A, 16A, 18A, 20A, 22A, 26A, 28A, 30A, 32A, July, 1950) points out some of the problems.

I can give a partial, nonconclusive answer to Mr. Renwick's specific questions based on the experiences within our own plant. They are as follows:

1. Our plant has replaced steel tubes in no. 1 and no. 2 effects with type 304 stainless welded tubes. This was in order to decrease corrosion. It was also necessary to replace the vapor dome in both these vessels with type 304 stainless clad material.

2. We eliminate scale by washing out weekly with hot water and each year have all five effects acid cleaned by Dowell Inc. of Tulsa, Okla. I'm sure that the Dowell Co. would give any requested information to Mr. Renwick on the method they use.

3. We are of the opinion that the scaling and corrosion taking place on the vapor side of the mild steel tubes in evaporators is caused by the formation of iron sulphide due to the attack by sulpho compounds. We have attempted in our second effect a $2^1/_2\%$ nickel content tube, and we know of others who have tried up to 5% nickel, but our experience was not much better than that with the straight charcoal steel tube.

4. Our experience has shown that type 304 stainless steel no. 16 gage 2-in. o.d. welded type tube gives good results.

S. J. Baisch, *Chairman*
TAPPI Corrosion Committee
Thilmany Pulp & Paper Co.
Kaukauna, Wis.

To the Editor, *Tappi:*

I do not know of any recent TAPPI reports pertaining to this problem, but there is quite a literature on the general subject of corrosion in alkaline pulping equipment including evaporators. I shall not attempt to give a complete bibliography at this time. I believe two of the more recent articles are D. L. Horrigan, *Paper Trade Journal*, Oct. 5 and 12, 1951, and H. O. Teeple, *Paper Industry*, April, 1951.

Turning now to Mr. Renwick's specific questions I would like to give some answers as follows not so much from the viewpoint of TAPPI as from that of the experience in our own company and others that I know of personally.

1. There is a definite tendency in the United States paper industry to replace mild steel with stainless steel tubes in sulphate black liquor evaporators. Several mills, including our own at Charleston, S. C., have type 304 stainless steel tubes in all effects (ours are sextuple). However, I believe the general practice is to use stainless steel only for the first two effects and also in the surface condenser. There are still some older evaporators with carbon steel tubes throughout which are replaced as needed.

2 and 3. Methods of eliminating scale and corrosion on the vapor side of evaporator tubes: I believe the prevalent method is to wash out periodically with hot water, perhaps once a week, and with caustic cooking liquor at less frequent intervals. The wash-out schedule is quite variable depending on the efficiency of the vapor separators, the nature of the liquor, and the degree to which the mill is pressed for capacity and efficiency. These wash-outs are to combat scale and do not prevent corrosion. This corrosion is of an acid type and can only be prevented by more efficient separation from the vapors.

4. Typical stainless steel tubes for sulphate black liquor evaporators of the long tube vertical type are 2 in. diam., 17 gage, type 304.

It is correct as implied in Mr. Renwick's letter that stainless steel tubes are used not only to combat corrosion but to obtain a higher capacity due to the thinner tubes and reduction of scale.

N. Shoumatoff
West Virginia Pulp & Paper Co.
New York, N. Y.

WVP Tests

To the Editor, *Tappi:*

We have been given a report indicating that you are scientifically measuring moisture resistance in wrapping material. We would like to consider that you are in a position to furnish us with a part of your experienced testing data on moisture resistance in various kinds of wrapping materials for bread.

First, please be kind enough to let us know the testing method of moistureproof resistance specified by TAPPI expressed as grams per square meter per hour of water vapor diffused at 100°F.

Second, please indicate moistureproofness in the following wrapping materials for bread measured by TAPPI testing methods: (1) 37-lb. wax paper; (2) cellophane 300 MST; (3) cellophane 450 MST; (4) polyethylene; (5) other typical wrapping materials for bread.

KATUITI HOROSE
Dainihon Transparent Paper Mfg. Co. Ltd.
Osaka, Japan

To the Editor, *Tappi:*

For Mr. Horose's benefit we may quote the following approximate WVP values (TAPPI 464 m-45):

	WVP (g./sq. m./24 hr.)
1. 37-lb. waxed paper (24-lb base stock)	2 to 6 flat, 25 to 200 creased
2. 300 MSAT-86 cellophane	4 to 6 flat, 8 to 12 creased
3. 33-lb. waxed glassine(25-lb. base stock)	0.25–3.0 flat, 15 to 50 creased
4. 450 MST-53 G cellophane	12 to 19 flat
5. 450A MSAT-84 cellophane	3.9–4 flat
6. Pliofilm 140 PD	0.5 to 6.8 flat
7. Polyethylene	10; to 2.0 flat

We find the Institute Method 541 more convenient since the high temperature controlled conditions are achieved by simply heating air from the controlled laboratory.

FRANS VAURIO, *Research Assistant*
Institute of Paper Chemistry
Appleton, Wis.

Laminating Adhesives

To the Editor, *Tappi:*

I noticed in *Tappi,* October, 1954 (page 153A) that you seem to have heard of our water-resistant adhesives, and probably received erroneous advice on the subject. During the past year, we have finally, after years of work, arrived at formulations which corrugate properly. We have been working with the Philadelphia Quartz Co., and several patents have been issued or are pending. The companies mentioned in answer to your query have nothing which will perform as well or at as low a cost. We have years of experience on water-resistant laminating. For water-resistant corrugating, we recommend "Stixso WP." This is made up at 70 to 85°F., and will run as fast as your machine. It gives excellent strength wet or dry; better than obtained by any other practical adhesive. It contains Buckeye protein, soy flour, and sodium silicate, in proper proportions. No other isolated protein now available will do this. Cost is competitive with inferior products.

For water-resistant solid fiber board, we recommended Buckeye Pro-Lam, or Buckeye protein-clay-silicate. These are also made up cold, at high solids and need no heat. They are used at speeds up to 500 f.p.m. without heat, and make an exceptionally flat board. Because Buckeye Pro-Lam is not tacky, it is especially useful for lining thin paper, such as book, to heavy board. Both these adhesives will also work on building board, wall board, etc., even when asphalt treated. Performance is exceptionally fast and all bonds will pass U. S. "V" and "W" board specifications. In the matter of cost, no water-resistant adhesive is close. One of our customers regularly laminates at a cost of 18 cents per thousand square feet, but the average cost is about 25 cents per thousand. Building boards require about 95 cents worth per thousand, depending on smoothness and type.

If you would like more details, formulas, samples, directions, and other data, write us. There will be no charge or obligation. We suggest that you send us a few square feet of the paper or board you desire to laminate, and tell us what principle your laminator operates on. We can then recommend a formulation and estimate your cost.

J. D. ATKINSON, Jr., *Manager, Protein Sales*
Buckeye Cotton Oil Co.
Memphis, Tenn.

Cellulose Abstracting Services

To the Editor, *Tappi:*

May I draw your attention to some errors which appear in the text and in the Appendix of your interesting article on "Abstract Services Covering the Chemistry of Cellulose and Related Fields" in *Tappi* 37, No. 9: 157A–167A (1954) as regards our publications.

1. Forestry Abstracts and Forest Products and Utilization Abstracts, *prepared* by this Bureau, are *published,* both of them, by the *Commonwealth Agricultural Bureaux, Farnham Royal, Bucks* (not London). Strictly speaking, they are "Commonwealth" publications, i.e., not only "British."

2. Publication of Forestry Abstracts started in 1939, not 1946.

3. Volume 14 (1953) contained 4050 Abstract and Title notices, not 1300. (The 1954 volume, Vol. 15, contains 4434.)

4. Forestry Abstracts, as well as its separate, Forest Products and Utilization Abstracts, is based on literature in 30 languages.

5. I should mention also that it has been decided (as announced with Vol. 15 (3)) to discontinue the issue of the separate, Forest Products and Utilization Abstracts, after the current number, 15 (4).

THE DIRECTOR
Commonwealth Forestry Bureau
Imperial Forestry Institute
Oxford, England

RECENT BOOKS

Cellulose and Cellulose Derivatives, Part II. 2nd Ed. Edited by Emil Ott and Harold M. Spurlin, Hercules Powder Co. Interscience Publishers, New York, 1954. Cloth, 6 × 9, 1055 pages. $12.

This book is the fifth in the High Polymer series of Interscience Publishers, published as a revised and enlarged second edition. Several TAPPI members have collaborated in its preparation.

The main sections deal with the preparation of cellulose from its natural sources, bleaching and purification of wood cellulose, properties and treatment of pulp for paper, and derivatives of cellulose.

The chapter on wood pulp was prepared by W. F. Holzer, Crown Zellerbach Corp. Arthur F. Martin, Hercules Powder Co., prepared the chapter on cotton linters. Harry F. Lewis, Institute of Paper Chemistry, wrote the chapter on rags. S. D. Wells, formerly of The Institute

of Paper Chemistry, prepared the chapter on bast fibers. The chapter on bleaching was written by R. S. Hatch, Hudson Pulp and Paper Co. James d'A. Clark was the author of the chapter dealing with stock preparation.

The reputation of these authors assures a high quality text.

Magnetic Control of Industrial Motors. 2nd Ed. By Gerhart W. Heumann, General Electric Co. John Wiley & Sons, New York, Cloth, 6 × 9, 714 pages. $9.50.

This book is one of a series written by General Electric Co. authors for the advancement of engineering practice. With the aid of this book it should be possible for an engineer to select the proper type of controller for a given application. The relative merits of full voltage starting and reduced voltage starting are discussed.

Among the subjects covered are principles of a. c. and d. c. motor operation, contactors and relays, electronic devices, resistors and rheostats, control panels, amplidyne control circuits, protection, solenoids, thrusters and brakes, and maintenance of control equipment. The book may be considered as an unusually valuable handbook in dealing with these subjects.

Physical Methods of Organic Chemistry, Part II. 2nd Ed. Edited by Arnold Weissberger, Eastman Kodak Co. Interscience Publishers, New York, 1954. Cloth, 6 × 9, 433 pages. $8.50.

Forty-one contributors are associated with the editor in the preparation of this text which is devoted to a comprehensive presentation of the techniques which are used in the organic laboratory and which are available for the investigation of organic compounds.

Among the subjects covered are electron microscopy, microspectroscopy, measurement of dielectric constant and loss, neutron diffraction, viscometry of dilute polymer solutions, determination of crystal structure by x-ray diffraction, determination of magnetic susceptibility, and determination of radioactivity.

Organic Chemistry—A Brief Course. By Robert W. Getchell, Iowa State Teachers College. McGraw-Hill Book Co., New York, 1954. Cloth, 6 × 9, 278 pages. $4.00.

Organic chemists now recognize about 500,000 compounds, natural and synthetic. The present volume was written for the benefit of individuals who are not organic chemists but who find it desirable to know the fundamentals about the subject. The subjects covered under aliphatic and aromatic compounds are integrated throughout the book.

The subjects covered are the usual ones for a book on organic chemistry, coal tar products, alcohols, phenols, halogen derivatives, ethers, ketones and aldehydes, nitro and azo compounds, esters, fats, detergents, sterioisomerism carbohydrates, plastics, rubber, proteins, vitamins, enzymes, hormones, and polynuclear and heterocyclic compounds.

The method of treating these subjects is the feature of the volume. Although the subject is not oversimplified it is a useful text for individuals who find it necessary to review the subject from time to time.

Low Temperature Test Methods and Standards for Containers. Available from the Quartermaster Food and Container Institute for the Armed Forces, 1819 Pershing Rd., Chicago 9, Ill.

The present paper-bound volume, 126 pages, is the first in a series on Research in Package Engineering and features a number of papers presented during a symposium at Chicago, Ill., on Dec., 10, 1953, conducted by the Quartermaster in cooperation with the National Research Council.

Among the papers presented were the following: Importance of Low-Temperature Performance in Military Packaging; Effect of Low Temperatures on Containers; Water Vapor Permeability of Sheet Materials; Background of Use of Multiwall Bags by the Armed Forces; Testing Multiwall Bags at Low Temperatures; Effect of Low Temperatures on Container Components; Low Temperature Degradation of Flexible Barrier Materials.

Organic Analysis II. Edited by I. M. Kolthoff, E. S. Proskauer, and A. Weissberger. Interscience Publishers, New York, 1954. Cloth, 6 × 9, 372 pages. $8.50.

The present text is the second volume in a series on the subject of organic analysis, giving reliable and critical information about new methods and procedures, reflecting the modern trend by emphasizing functional group analysis and instrumental techniques.

The contents consist of contributions by individual authors and in Volume II include such subjects as micro determination of carboxyl groups, determination of esters, determination of nitro, nitroso, and nitrate groups, coulombetric methods, application of polarography, methods based on reaction rates, phase solubility analysis, countercurrent distribution, and the applications of lithium aluminum hydride to organic analysis.

Deterioration of Materials. Edited by Glenn A. Greathouse and Carl J. Wessel of the Prevention of Deterioration Center, Division of Chemistry and Chemical Technology, National Academy of Sciences, National Research Council. Reinhold Publishing Corp., New York, 1954. Cloth, 6 × 9, 835 pages. $12.00.

Out of war efforts, especially in the consideration of the problems of survival, there are often technical developments of widespread usefulness in the ordinary activities of peacetime living. The present text now reveals some of the findings in Project AN-14 of the Office of Scientific Research and Development.

Twenty-four specialists, several of whom are known to the paper industry, collaborated in preparing the text.

Part I deals with some important factors in deterioration such as climate, chemical, physical, and biological agents.

Part II features several materials and methods of their preservation. These materials include metals, wood and wood products, paper, textiles and cordage, leather, plastics and rubber, and paint, varnishes, and enamels.

Part III relates to the preservation of electrical and electronic equipment, optical instruments, and photographic equipment.

Part IV considers dehumidification, packaging, and toxicological evaluation of preservatives.

A useful appendix by Sherman Booth provides a key to government specification numbers, a class of information which is frequently sought by investigators.

The 52-page chapter on paper by Carl J. Wessel gives much valuable information relating to biological deterioration due to slime and microbiological attack; physical deterioration due to light, heat, and moisture; and chemical deterioration due to acid gases of the atmosphere and the pressure of deleterious materials in paper. The five pages of literature citations are of particular value.

Note: Books reviewed in this column may be obtained from the Technical Association of the Pulp and Paper Industry, 155 E. 44th St., New York 17, N. Y.

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NATIONAL MEETINGS

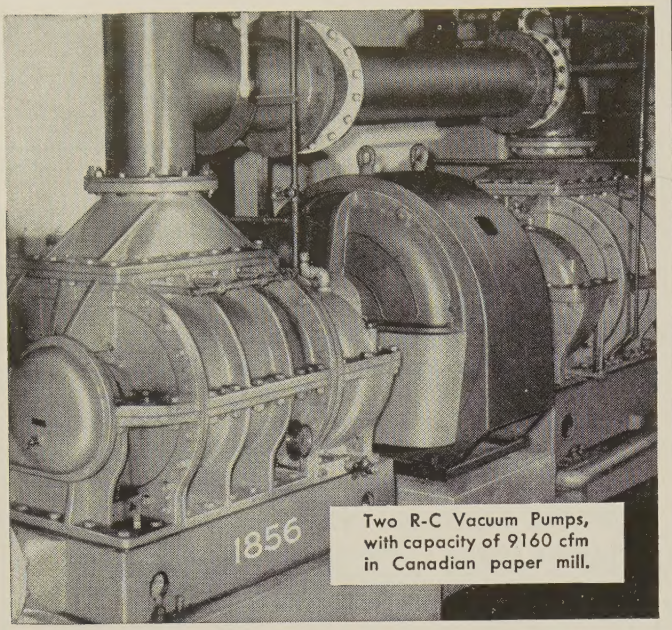
Fortieth Annual Meeting, Commodore Hotel, New York, N. Y., February 21–24, 1955

Sixth Coating Conference, Statler Hotel, Cleveland, Ohio, May 23–25, 1955.

Second Mechanical Pulping Conference, Poland Spring House, Poland Spring, Me., September 19–21, 1955.

Tenth Engineering Conference, Rice Hotel, Houston, Texas, October 31–November 3, 1955.

Ninth Alkaline Pulping Conference, Hotel Patten, Chattanooga, Tenn., October 19–21, 1955.



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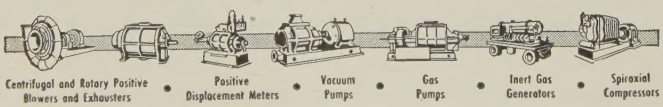

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